The Rosenfeld Effect Symposium

Can We Define, Let Alone Fix, Dangerous Climate Change?

Stephen H. Schneider

Dept Biological Sciences

&

Woods Institute for the Environment

28 April 2006

Berkekley California

[Also see: climatechange.net]

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(way too many effects to measure!!)

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(Typical Photo Opp for Art)


FOR
CALIFORNIA'S
FUTURE

Munich Re:
"We need to stop this dangerous experiment humankind is conducting on the Earth's atmosphere."

What does “dangerous” climate change really mean?

Article 2 of the UN Framework Convention on Climate Change (UNFCCC) states that: The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The Framework Convention on Climate Change further suggests that "Such a level should be achieved within a time frame sufficient

- to allow ecosystems to adapt naturally to climate change,
- to ensure that food production is not threatened and
- to enable economic development to proceed in a sustainable manner."

“Dangerous” Climate Change

- Who decides what is “dangerous” in DAI?

“Dangerous” Climate Change

- Who decides what is “dangerous” in DAI?
- Many ways to define DAI

“Dangerous” Climate Change

Who decides what is “dangerous” in DAI?

Many ways to define DAI

Ultimately, not a scientific choice

Inuit to file anti-U.S. climate petition
Wed Jun 15, 2005 11:09 AM

OSLO (Reuters) - Inuit hunters threatened by a melting of the Arctic ice plan to file a petition accusing Washington of violating their human rights by fueling global warming, an Inuit leader said Wednesday.

Sheila Watt-Cloutier, chair of the Inuit Circumpolar Conference (ICC), also said Washington was hindering work to follow up a 2004 report by 250 scientists that said the thaw could make the Arctic Ocean ice-free in summer by 2100.

Watt-Cloutier, in Oslo to receive an environmental prize, said the inuits' planned petition to the 34-member Organization of American States (OAS) could put pressure on the United States to do more to cut industrial emissions of heat-trapping gases.

"It's still in the works, the drafting is still going on," she said of a long-planned petition to the OAS' human rights arm, the Inter-American Commission on Human Rights.

Climate Uncertainty

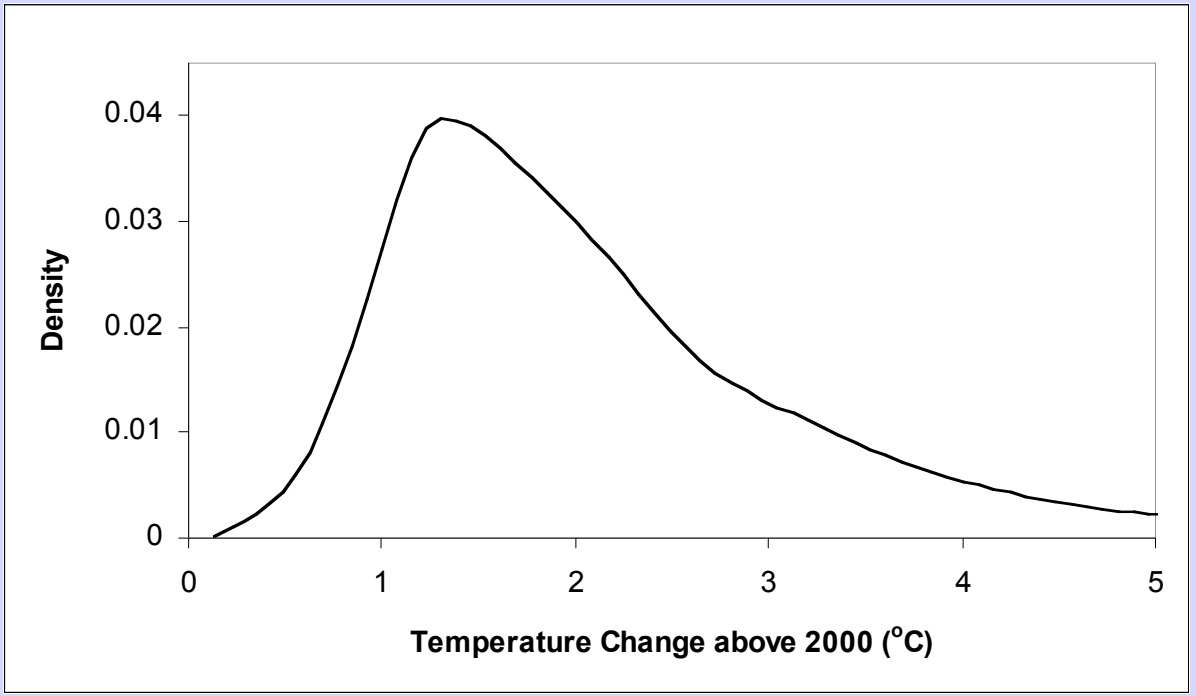
- Inherent uncertainty in projections of future climate

Climate Uncertainty

- Inherent uncertainty in projections of future climate
- Best guess → Range → PDFs

Climate Uncertainty

Climate Uncertainty



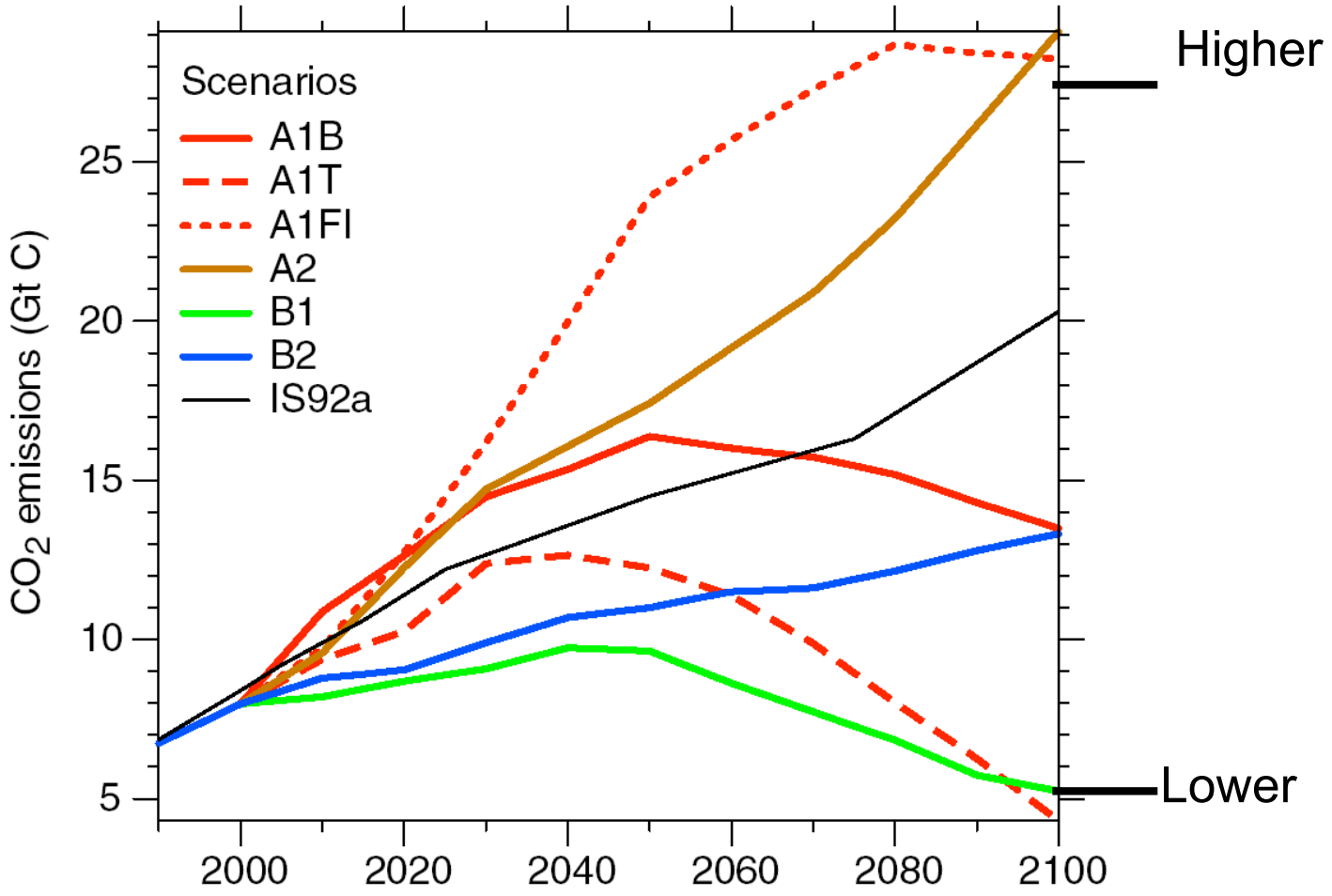
Climate Uncertainty

- Inherent uncertainty in projections of future climate
- Best guess → Range → PDFs
- Climate policy → risk management

Climate Policy Analysis

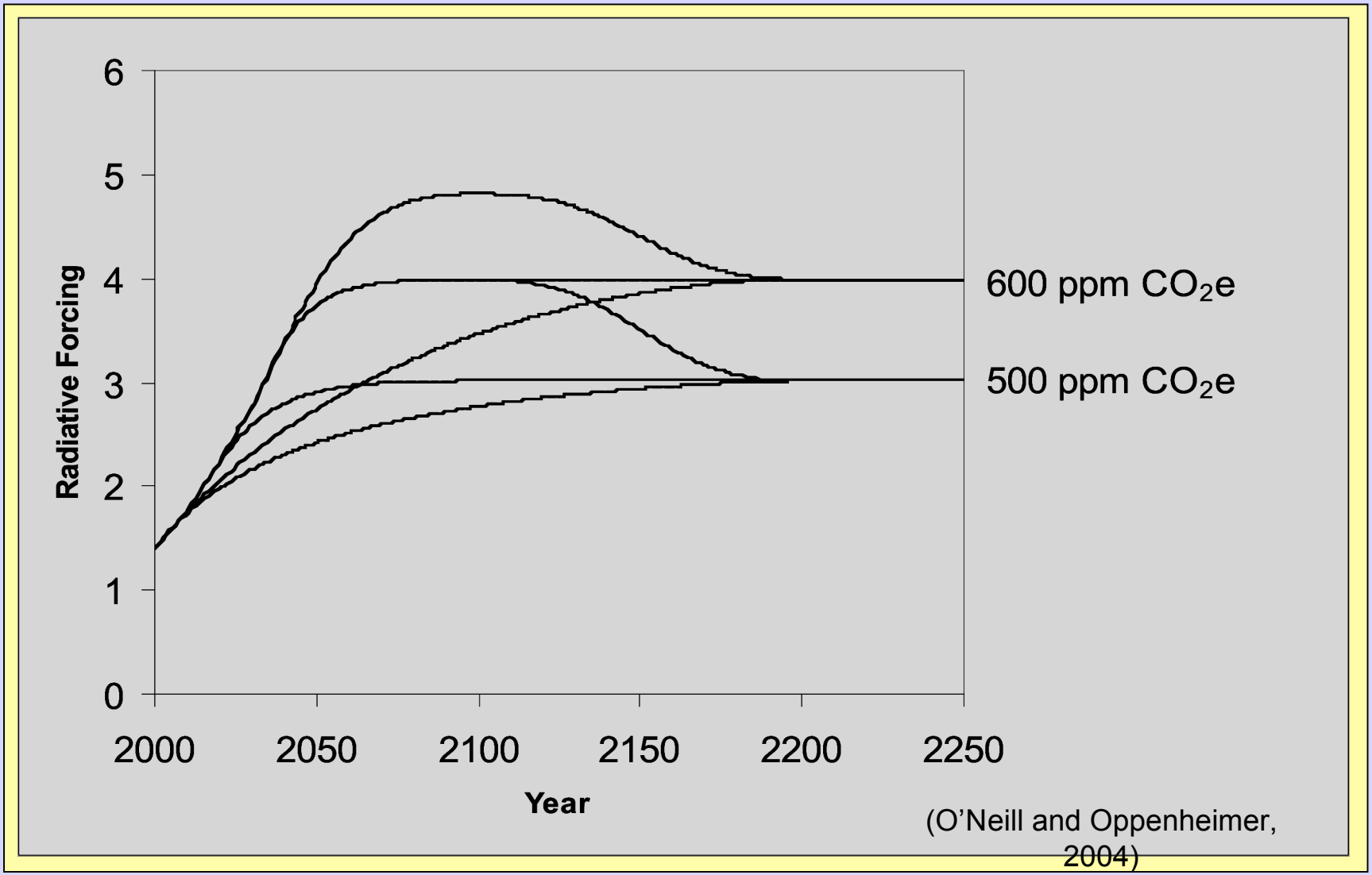
- Assess risk as a function of policy choices

What will be our future emissions?



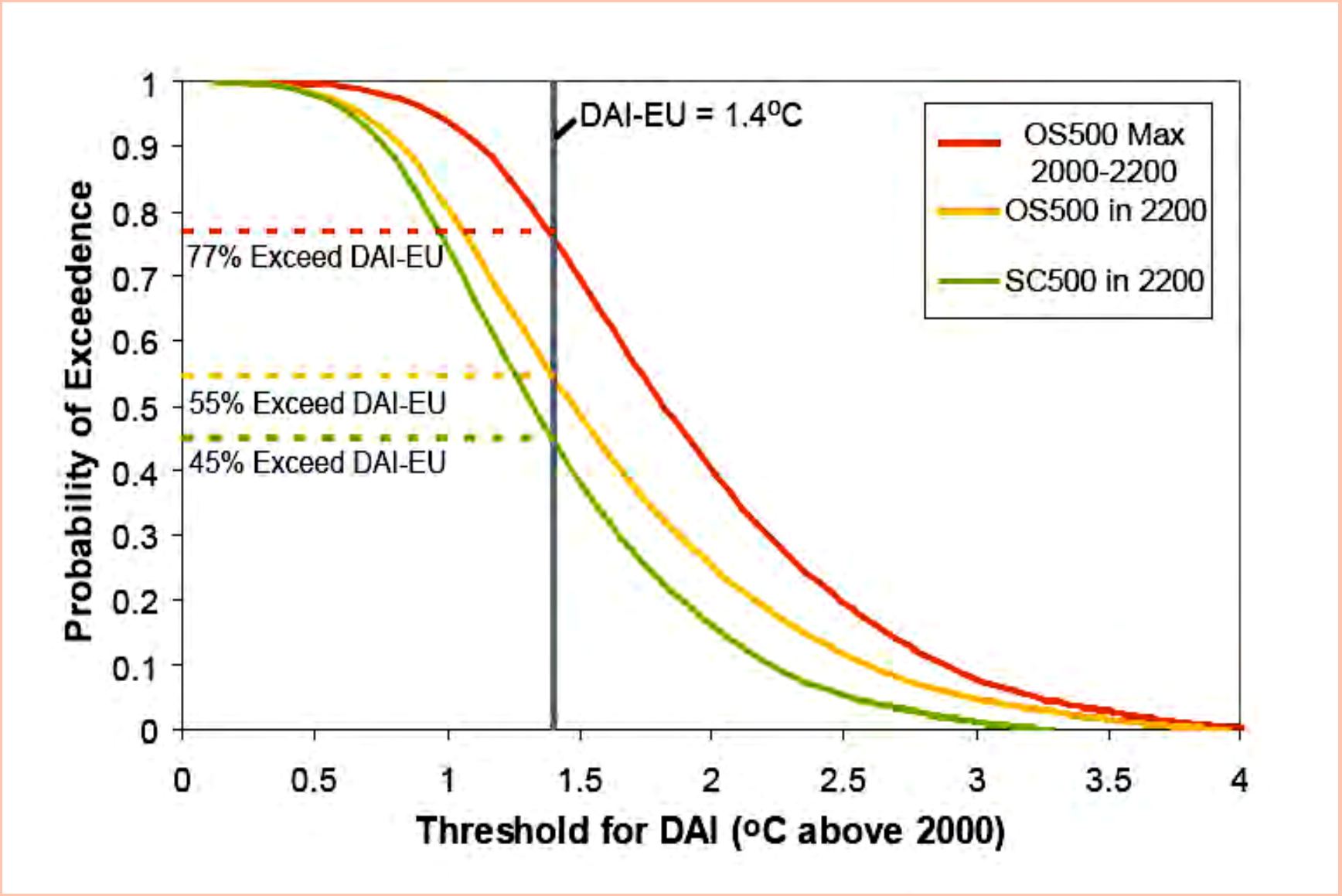
Source: Intergovernmental Panel on Climate Change

Emissions Scenarios



(O'Neill and Oppenheimer, 2004)

Source: Schneider and Mastrandrea, PNAS, Oct 2005



Source: Schneider and Mastrandrea, PNAS, Oct 2005

Risk = Probability x Consequence
[What metrics of harm?]

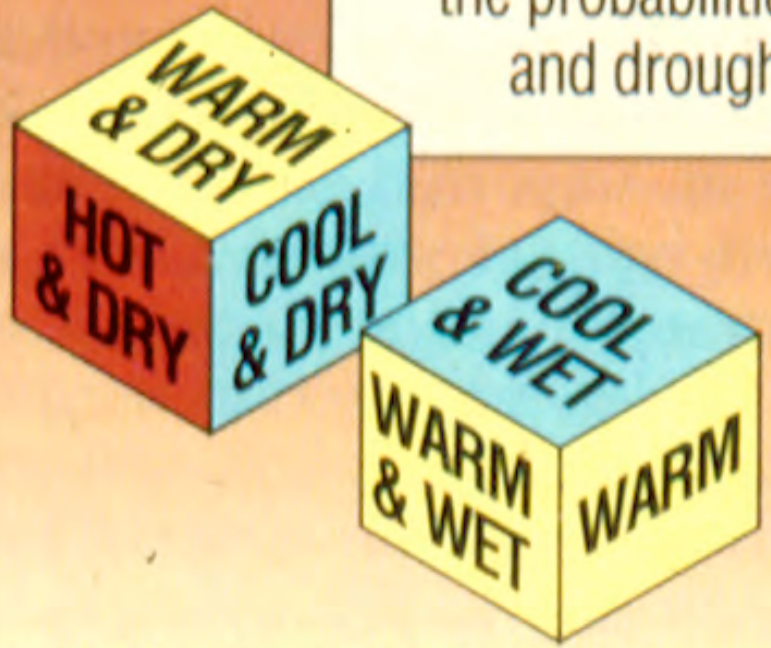
-$/ton C avoided
-lives lost/ton C avoided
-species lost/ton C avoided
-increased inequity/ton C avoided*
-quality of life degraded/ton

*Perception that prime generators of the risks are not accepting responsibility for their emissions or helping victims to adapt (e.g., OECD countries refusing to join in Kyoto Protocol) itself creates risks.

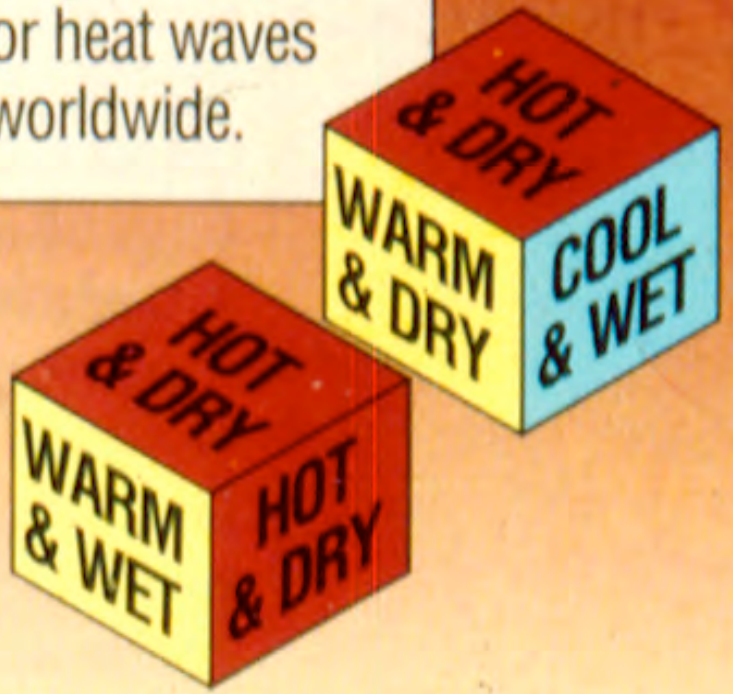
[Source: "The Five Numeraires", Schneider, Kuntz-Duriseti and Azar 2000]

Loading the Dice

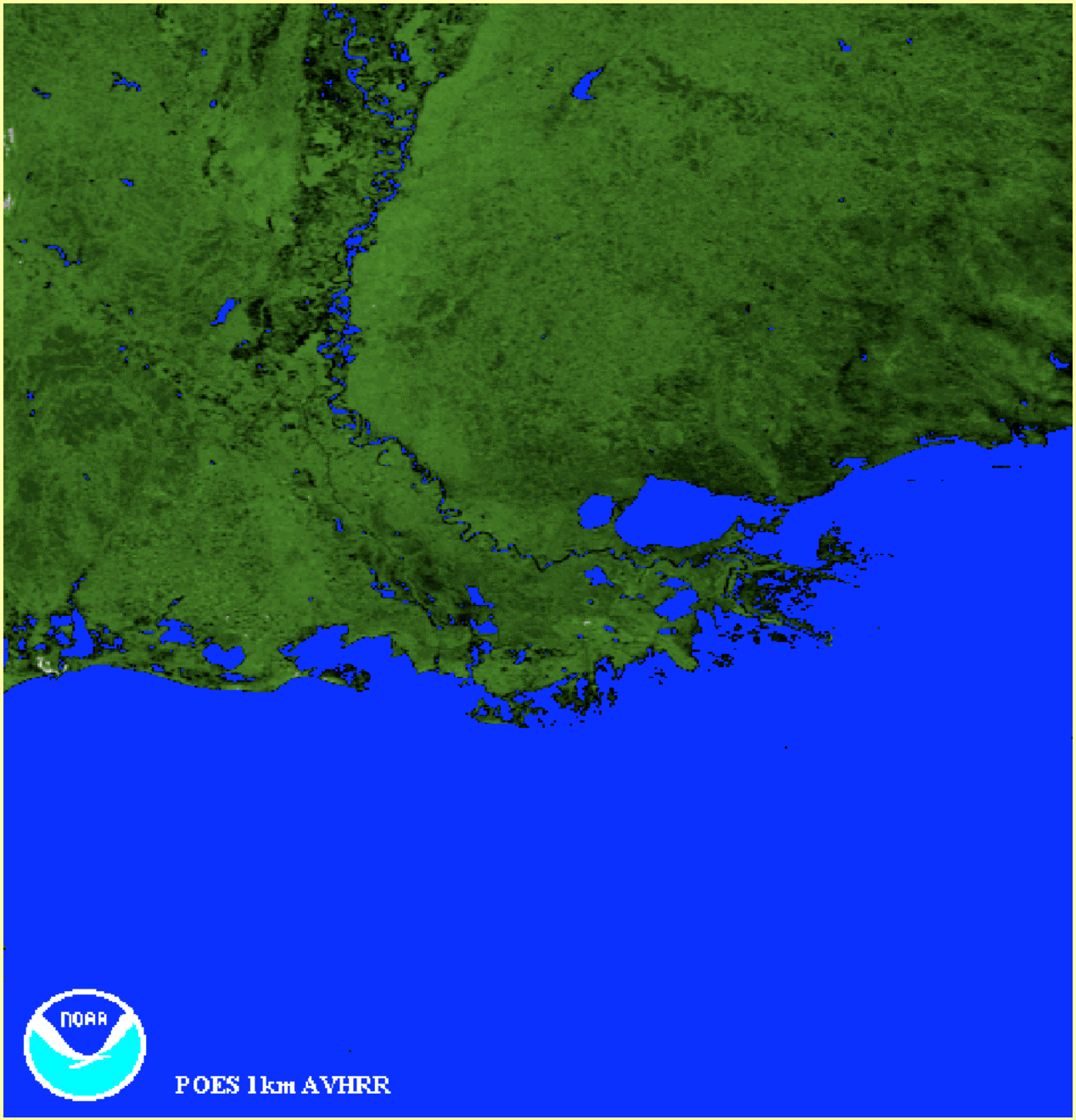
Greenhouse warming increases the probabilities for heat waves and droughts worldwide.

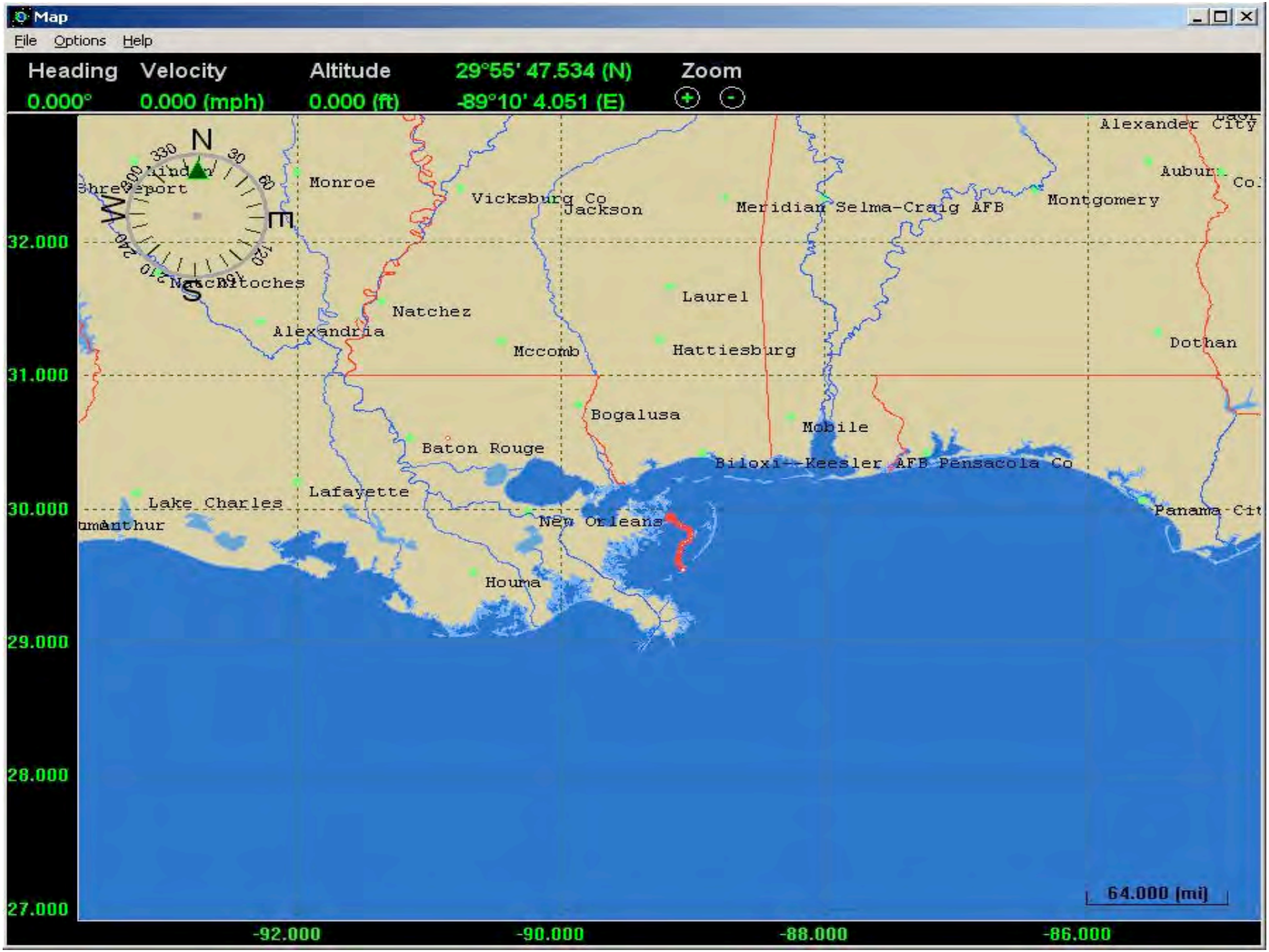


In Washington, D. C., the odds of five or more days in a row in July with temperatures greater than 95 degrees F. is now about one in six

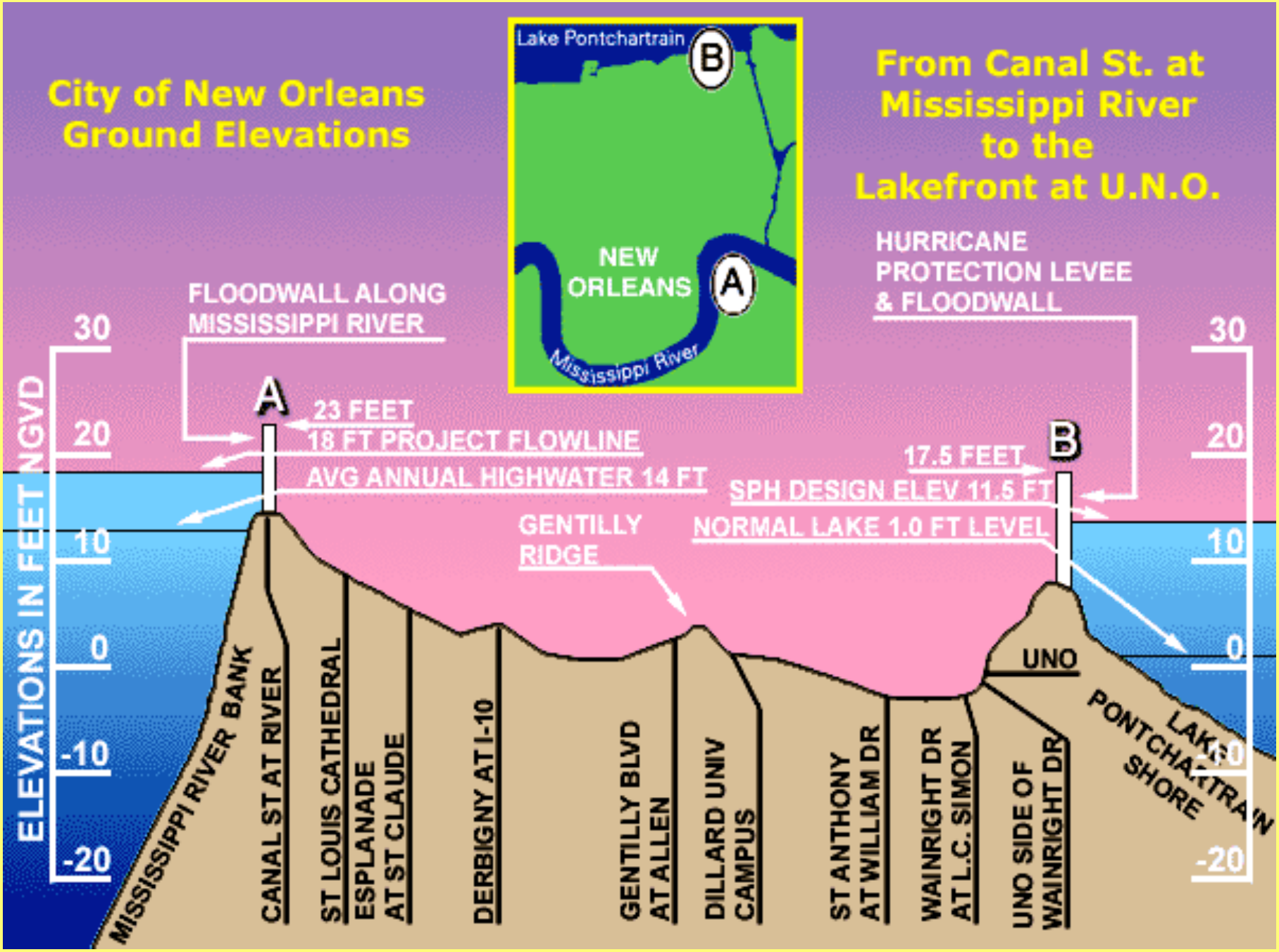


If the average temperature goes up by 3 degrees F., several colder faces are replaced with warmer ones—and the probability for a Washington, D. C., heat wave goes up to three in six


NOAA
POES 1km AVHRR


Map
File Options Help
Heading
0.000°
Velocity
0.000 (mph)
Altitude
0.000 (ft)
29°55' 47.534 (N)
-89°10' 4.051 (E)
Zoom
N
E
S
W
Monroe
Vicksburg Co
Jackson
Meridian
Selma-Craig AFB
Montgomery
Alexander City
Auburn
Natchez
Alexandria
Laurel
Mccomb
Hattiesburg
Dothan
Bogalusa
Mobile
Baton Rouge
Biloxi--Keesler AFB
Pensacola Co
Lafayette
Lake Charles
New Orleans
Houma
Panama Cit
32.000
31.000
30.000
29.000
28.000
27.000
-92.000
-90.000
-88.000
-86.000
64.000 (mi)


Hammond
Covington
Slidell
LaPlace
MSY
New Orleans
Metaire
Kenner
Harahan
Chalmette
Gretna
Harvey
Joyce Wildlife Area
Manchac Wildlife Area
Lake Maurepas
Lake Pontchartrain
Lake Pontchartrain Causeway (TOLL)
Lake Borgne
French Quarter
down town
Convention Center
Superdome
©2001 MHPCo
all rights reserved


City of New Orleans
Ground Elevations
From Canal St. at
Mississippi River
to the
Lakefront at U.N.O.
Lake Pontchartrain
B
NEW
ORLEANS
A
Mississippi River
FLOODWALL ALONG
MISSISSIPPI RIVER
HURRICANE
PROTECTION LEVEE
& FLOODWALL
ELEVATIONS IN FEET NGVD
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23 FEET
18 FT PROJECT FLOWLINE
AVG ANNUAL HIGHWATER 14 FT
B
17.5 FEET
SPH DESIGN ELEV 11.5 FT
NORMAL LAKE 1.0 FT LEVEL
GENTILLY
RIDGE
MISSISSIPPI RIVER BANK
CANAL ST AT RIVER
ST LOUIS CATHEDRAL
ESPLANADE
AT ST CLAUDE
DERBIGNY AT I-10
GENTILLY BLVD
AT ALLEN
DILLARD UNIV
CAMPUS
ST ANTHONY
AT WILLIAM DR
WAINRIGHT DR
AT L.C. SIMON
UNO SIDE OF
WAINRIGHT DR
UNO
LAKE PONTCHARTRAIN
SHORE

Adaptive Capacity?

-For New Orleans for greater than category 3 tropical cyclones:
low adaptive capacity

-Vulnerability is emergent property of coupled socio-natural system, influenced by risk-management decisions as well as environmental hazards

Seven criteria for assessing and defining key vulnerabilities:

1. magnitude
2. distribution
3. timing
4. persistence and reversibility
5. likelihood and confidence
6. potential for adaptation
7. “importance” of the vulnerable system

No single metric can adequately capture the diversity of key vulnerabilities, nor determine their ranking.

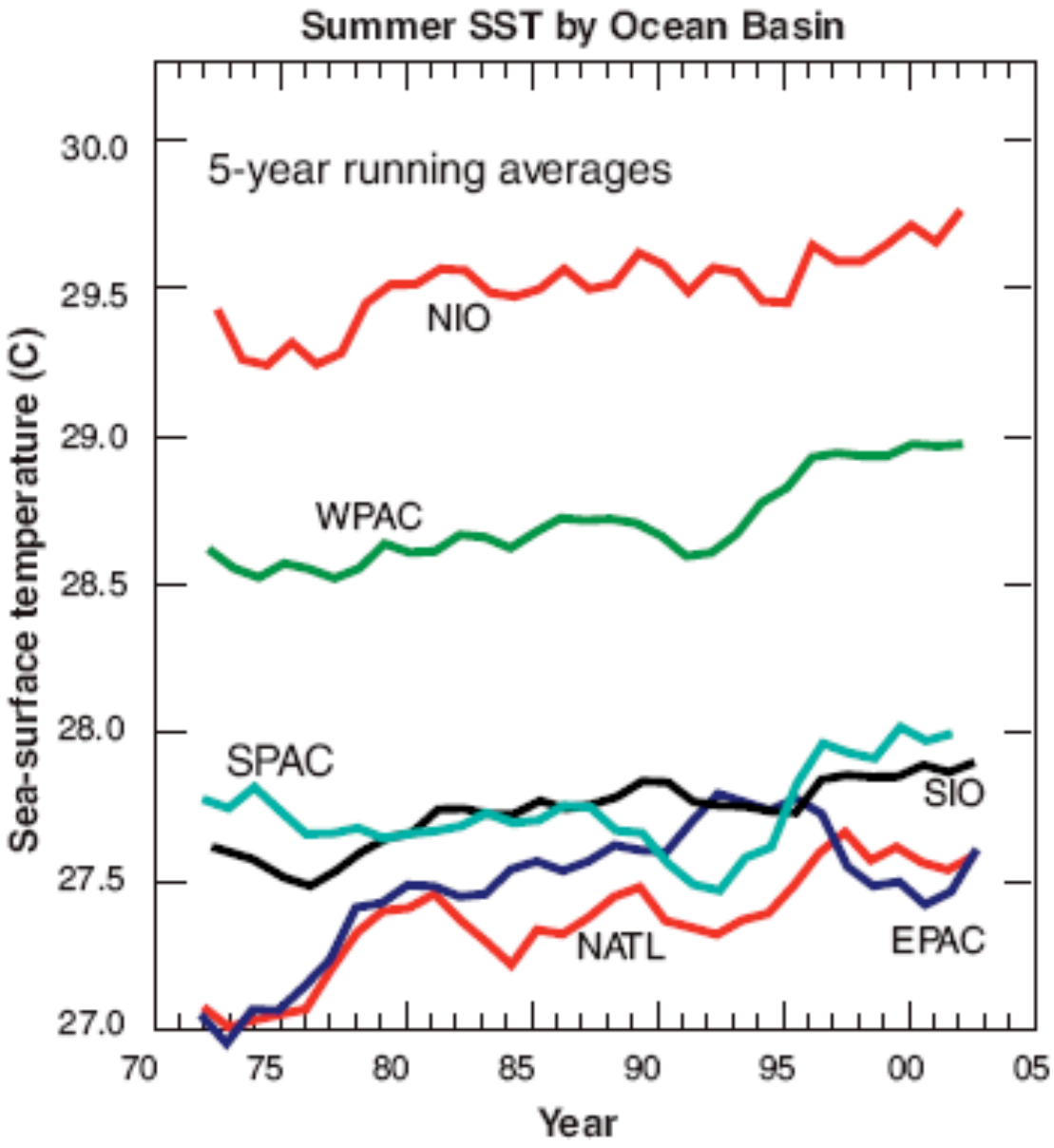


Fig. 1. Running 5-year mean of SST during the respective hurricane seasons for the principal ocean basins in which hurricanes occur: the North Atlantic Ocean (NATL: 90° to 20°E, 5° to 25°N, June-October), the Western Pacific Ocean (WPAC: 120° to 180°E, 5° to 20°N, May-December), the East Pacific Ocean (EPAC: 90° to 120°W, 5° to 20°N, June-October), the Southwest Pacific Ocean (SPAC: 155° to 180°E, 5° to 20°S, December-April), the North Indian Ocean (NIO: 55° to 90°E, 5° to 20°N, April-May and September-November), and the South Indian Ocean (SIO: 50° to 115°E, 5° to 20°S, November-April).

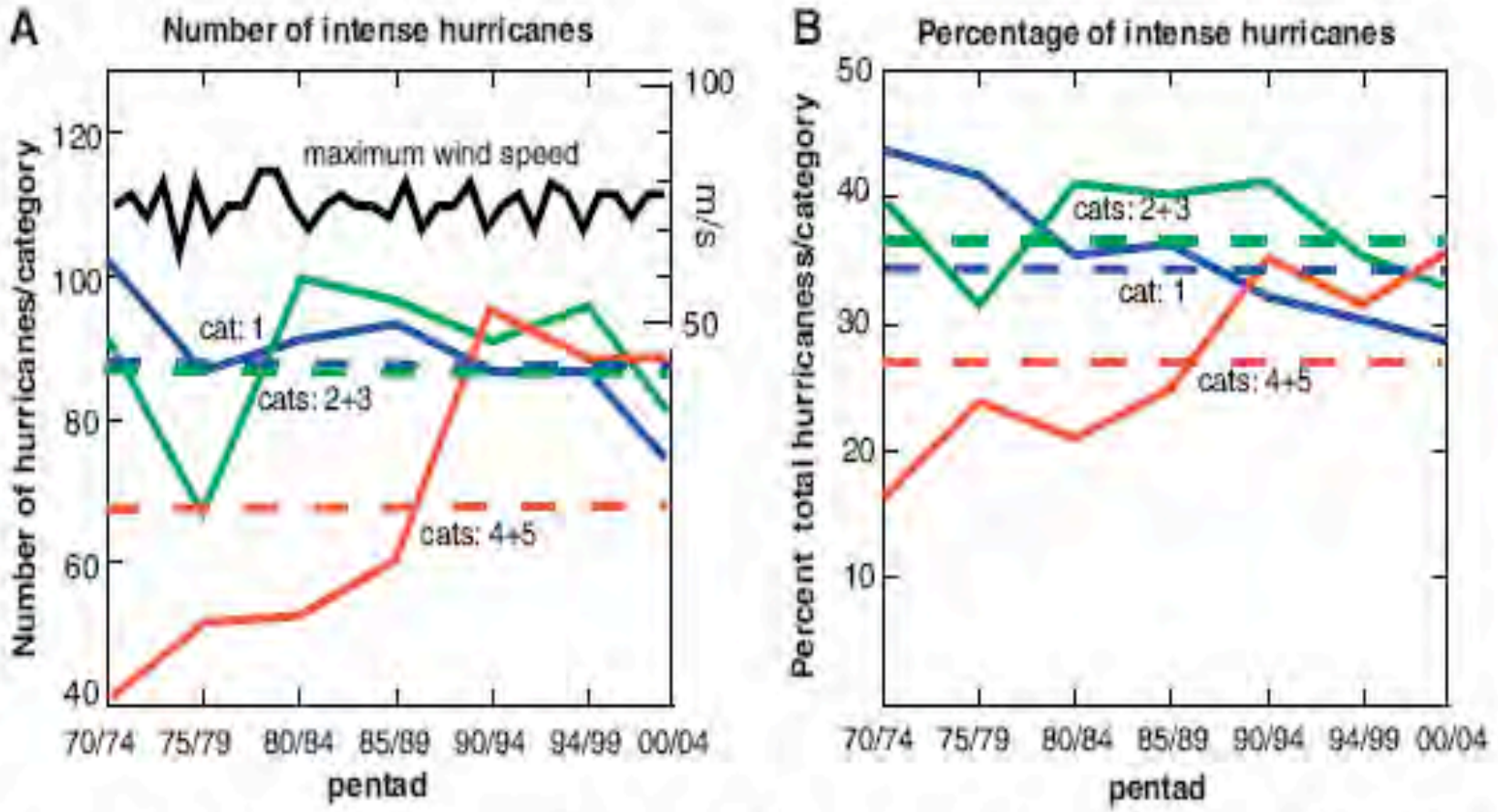


Fig. 4. Intensity of hurricanes according to the Saffir-Simpson scale (categories 1 to 5). (**A**) The total number of category 1 storms (blue curve), the sum of categories 2 and 3 (green), and the sum of categories 4 and 5 (red) in 5-year periods. The bold curve is the maximum hurricane wind speed observed globally (measured in meters per second). The horizontal dashed lines show the 1970–2004 average numbers in each category. (**B**) Same as (A), except for the percent of the total number of hurricanes in each category class. Dashed lines show average percentages in each category over the 1970–2004 period.

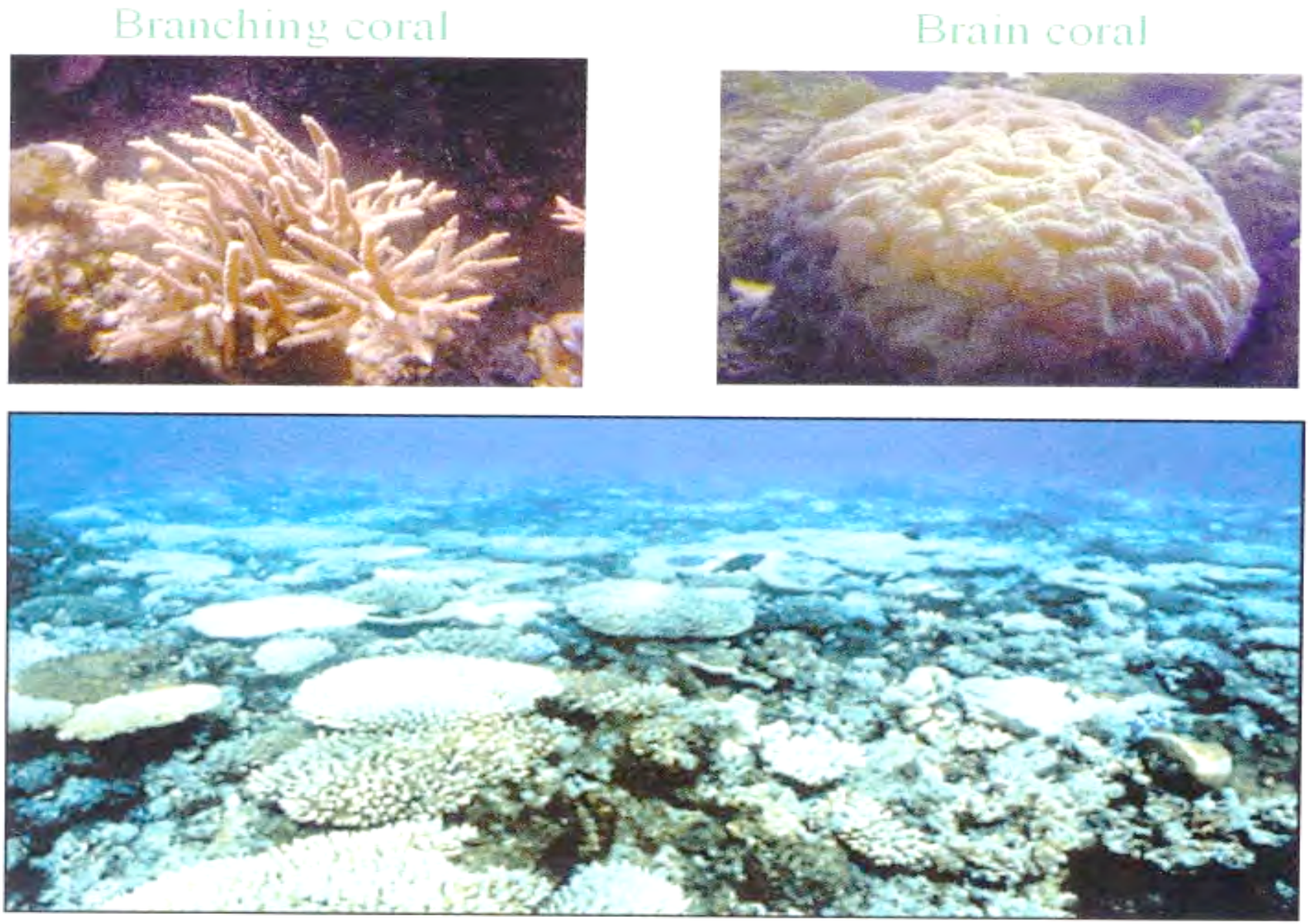
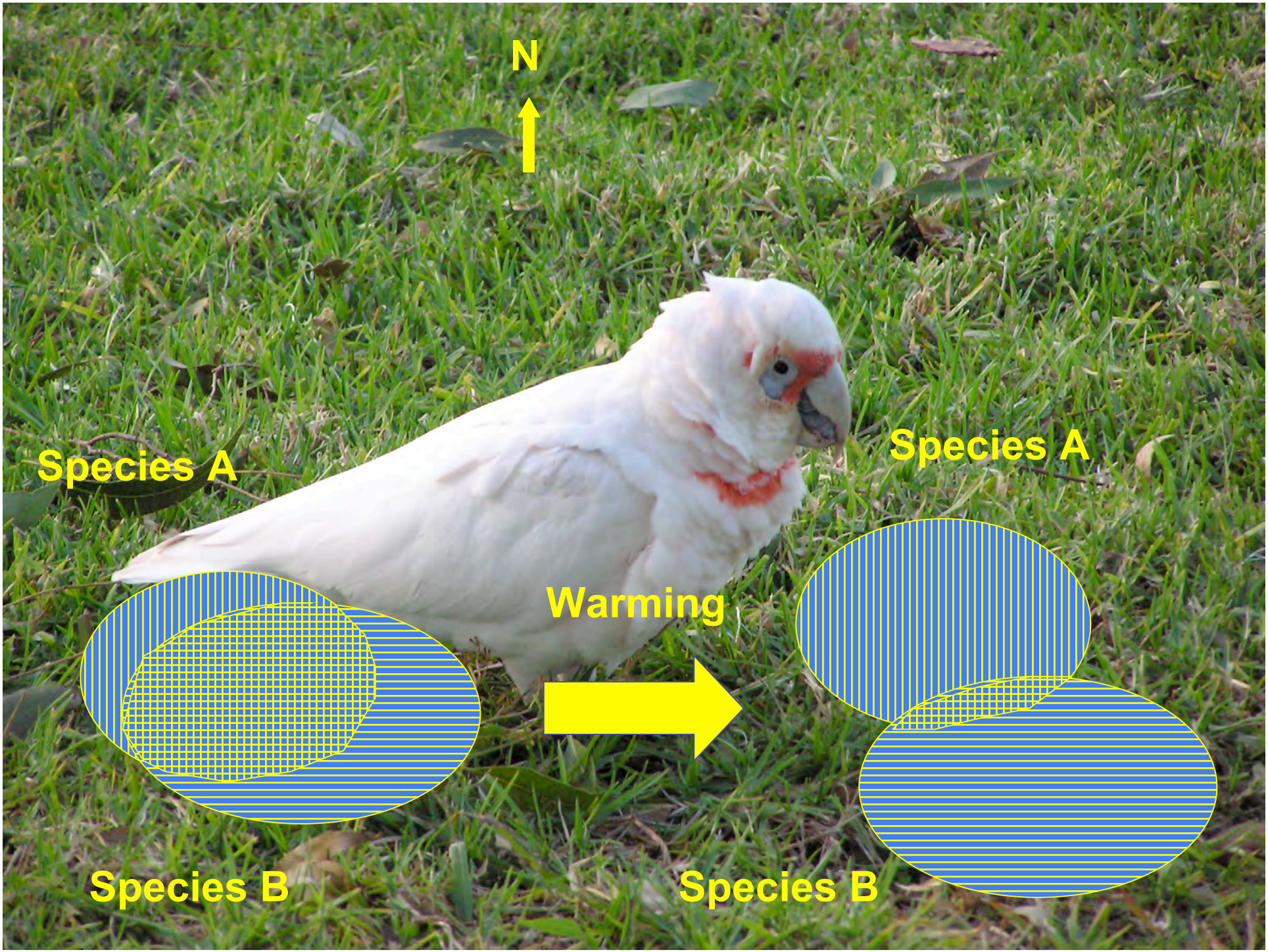
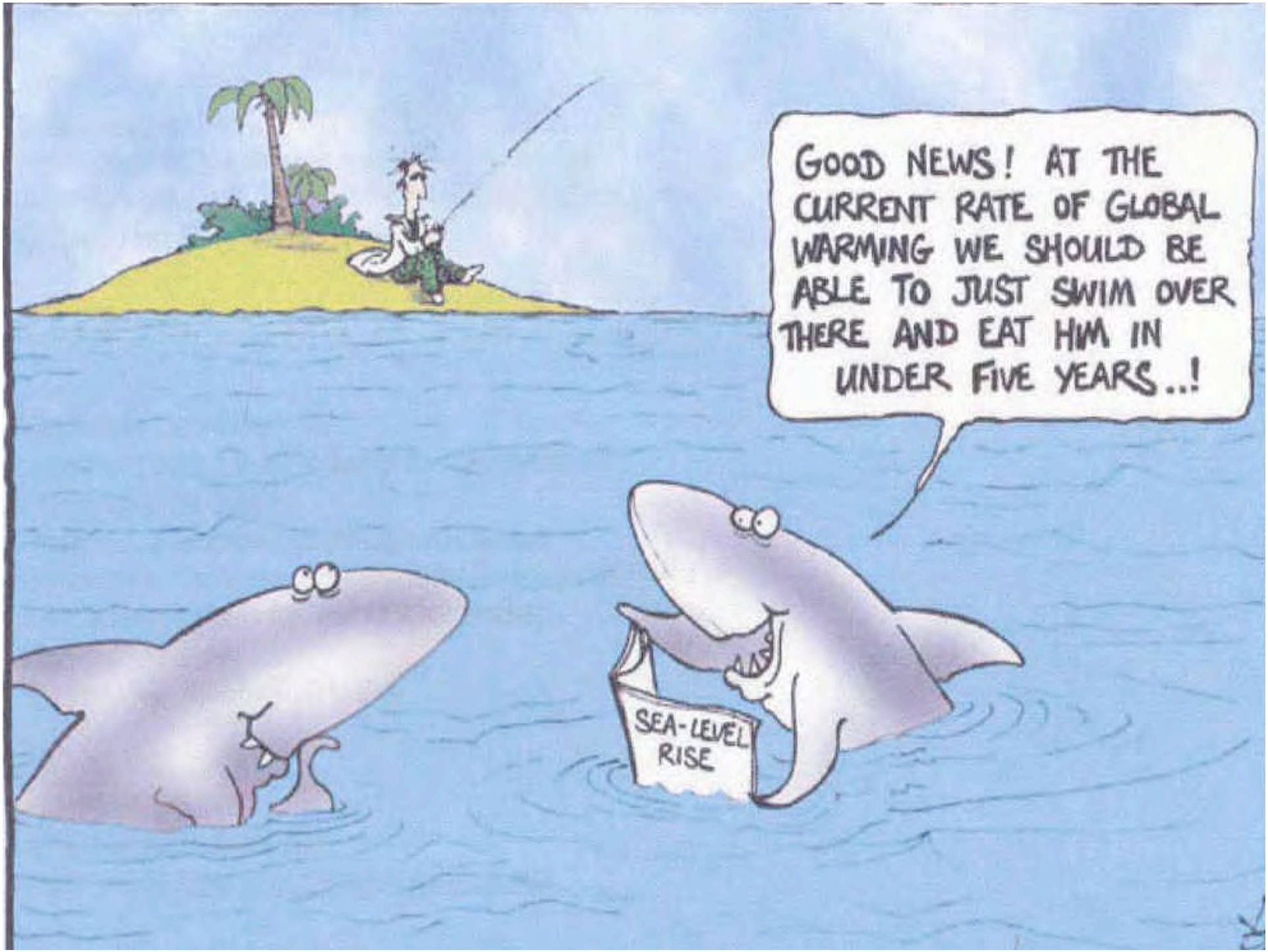
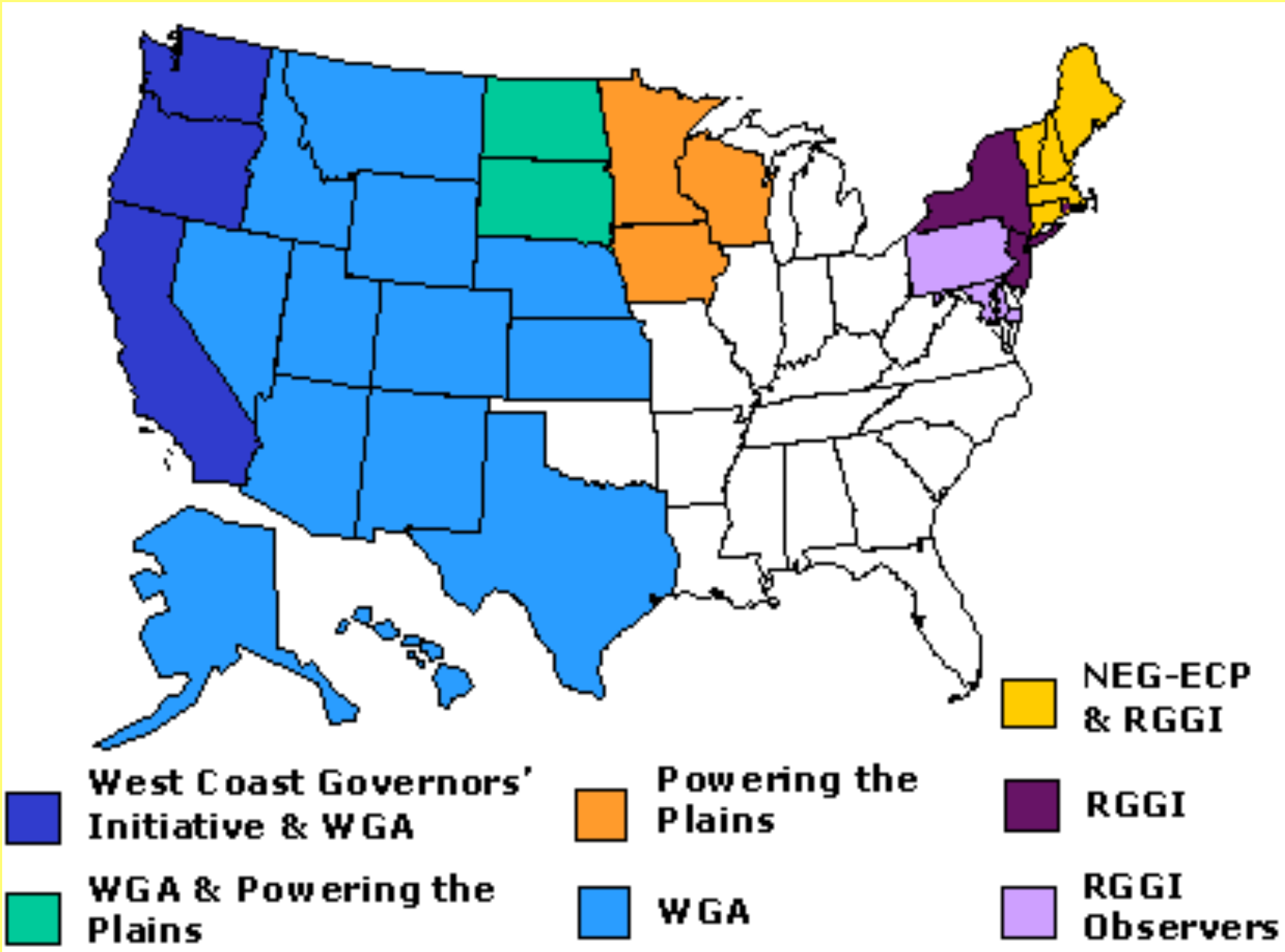


Figure 4-3: The diversity of corals could be affected with the branching corals (e.g., staghorn coral) decreasing or becoming locally extinct as they tend to be more severely affected by increases in sea surface temperatures, and the massive corals (e.g., brain corals) increasing.


N
Species A
Species A
Warming
Species B
Species B


GOOD NEWS! AT THE CURRENT RATE OF GLOBAL WARMING WE SHOULD BE ABLE TO JUST SWIM OVER THERE AND EAT HIM IN UNDER FIVE YEARS..!
SEA-LEVEL RISE


West Coast Governors' Initiative & WGA
Powering the Plains
NEG-ECP & RGGI
WGA & Powering the Plains
WGA
RGGI
RGGI Observers

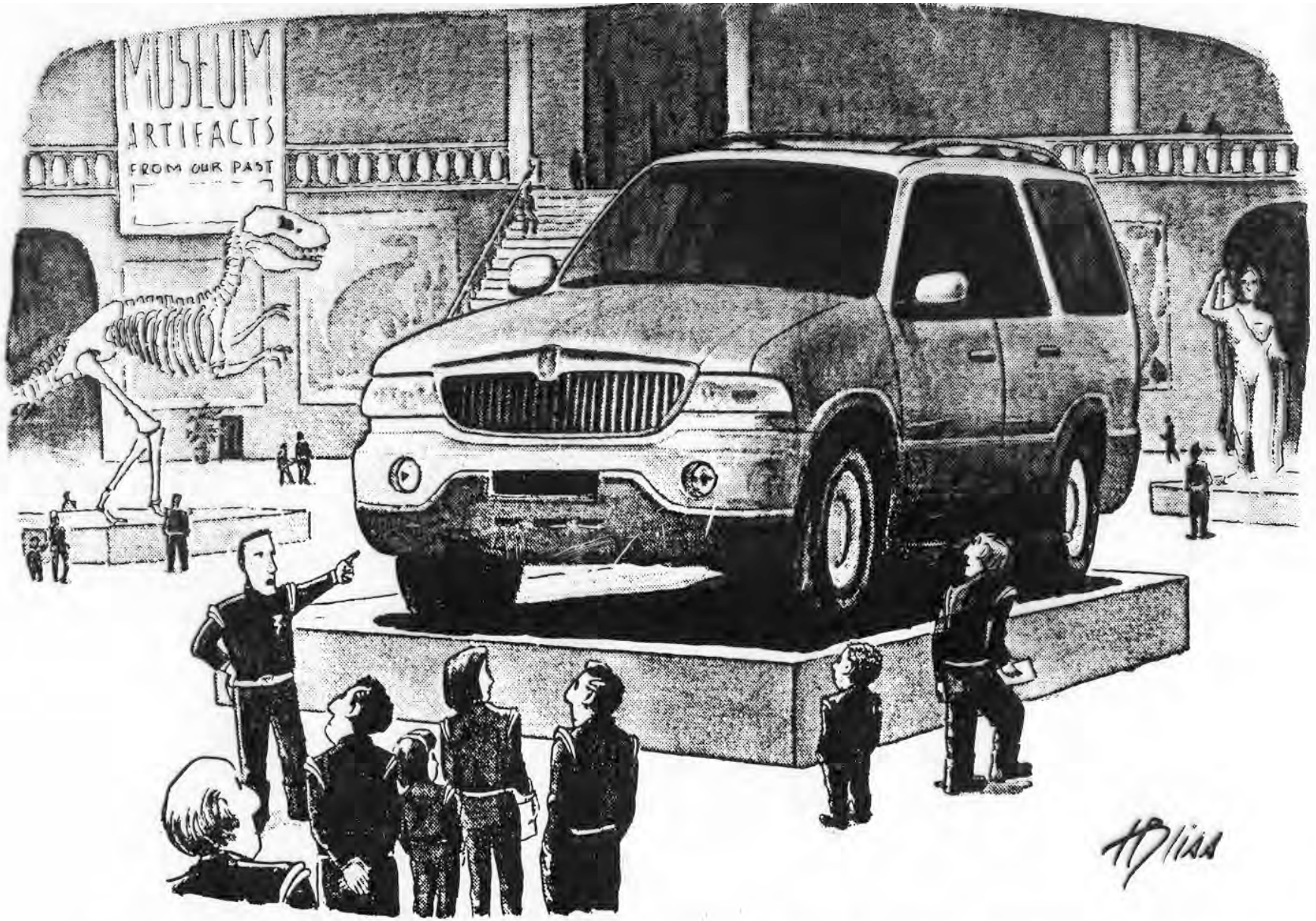
WHAT ARE THE FUTURE IMPLICATIONS OF POPULATION, AFFFLUENCE AND TECHNOLOGY GROWTH PROJECTIONS?

****

HOW CAN THE FUTURE BE SCIENTIFICALLY ANALYSED?

NOSTRADAMUS PREDICTS HOTTEST SUMMER IN HISTORY

FAMOUS seer Nostradamus wrote a clear and specific poem that reveals the horrors of our upcoming weather.



"We're not certain why they disappeared, but archeologists speculate that it may have had something to do with their size."

Large Vehicles Are the Solution, Not the Problem

By Sam Kazman

If you listen to journalists, you'd think sport-utility vehicles were more dangerous than Saddam Hussein. SUVs supposedly deplete the Earth's resources, poison its atmosphere and encourage rude driving. Worst of all, because of their size they allegedly pose a grave collision threat to just about anyone who ventures outdoors. According to a recent New York Times report, the worst safety hazard is yet to come—once these "expensive toys" depreciate and are sold by the "responsible family people" who now drive them, they'll be bought by teenagers who'll handle them even more recklessly.

These threats have been wildly overstated. And the solution proposed by many SUV critics, raising the federal fuel economy standards, would mean expanding a regulatory program that has already caused thousands of traffic deaths.

The federal Corporate Average Fuel Economy standards, enacted in the wake of the mid-1970s oil shocks, require each auto maker's annual output of new cars to meet a set fuel economy level. The current passenger-car CAFE standard is 27.5 miles per gallon; for light trucks, the standard is a more lenient 20.7 mpg.

The easiest way for car makers to meet ever-rising CAFE standards has been through continued car downsizing. As the National Highway Traffic Safety Administration itself noted, "weight reduction is probably the most powerful technique for improving fuel economy. . . . Each 10 percent reduction in weight improves the fuel economy of a new vehicle design by approximately 8 percent." The result was a CAFE-driven downsizing of approximately 500 pounds per car.

Smaller cars, however, are less crashworthy than similarly equipped large cars in practically every type of accident. According to a 1989 Harvard-Brookings study, CAFE-induced downsizing has increased car occupant fatalities by between 14% and 27%; that translates to between 2,000 and 4,000 extra deaths a year.

You'd think that NHTSA, an agency whose middle name is safety, would have brought this issue to the forefront of public attention. But instead NHTSA has repeatedly claimed that CAFE has no safety effect. In a 1992 court case brought by the Competitive Enterprise Institute and Consumer Alert, a panel of federal appeals judges blasted NHTSA's position as "fudged analysis," "statistical legerdemain" and "bureaucratic mumbo-jumbo."

If CAFE had been a privately produced product, it would long ago have been recalled as defective and its producer, NHTSA, jailed for the coverup. But because CAFE is a product of Washington rather than Detroit, it remains in place; worse yet, it threatens to expand in the face of the SUV "threat."

You're safer in a sport utility vehicle.

The overblown nature of that threat is demonstrated by a study issued last month by the Insurance Institute for Highway Safety. Journalists widely reported the study as re-emphasizing the need for action against SUVs, but its findings indicate otherwise. What the institute found was that collisions between cars and SUVs account for only 4% of car occupant fatalities.

Cars are most vulnerable in side impact collisions. According to the institute, in fatal collisions involving cars that are hit on the side by SUVs, the relative risk that the death will be in the car rather than the SUV is an apparently lopsided 27-to-1. But when this relative risk is broken down by car weight categories, it turns out that car-SUV mismatches are frequently outweighed by other common collision disparities. For example, the occupants of a light car struck in the side by a heavy car face a greater relative risk of death than when a heavy car is side-impacted by an SUV. That is, there is a greater mismatch between light cars and heavy cars than there is between heavy cars and SUVs.

What this means is that upsizing the car fleet may well be the most important step we could take toward improving safety. But upsizing, of course, is what CAFE currently restricts.

The same conclusion emerges from a 1997 NHTSA study, which was similarly characterized as indicting SUVs but which turns out, on closer analysis, to indict CAFE. A NHTSA press release touted the study's finding that a 100-pound decrease in SUV weight would prevent 40 fatalities per year, most of them in cars colliding with SUVs. But according to the study itself, this conclusion was not statistically significant; there might even be a net loss of life from such downsizing, and on balance the overall effect would be "negligible." More important, those minimal effects paled in comparison to the effects of a 100-pound *increase* in passenger car weight—a saving of over 300 lives a year. And the effect of this passenger car upsizing was found to be statistically significant, unlike the SUV downsizing.

Upsizing, however, would entail relaxing CAFE rather than tightening it—a move that would be totally alien to this administration and to its environmentalist supporters. The Sierra Club, for example, claims that higher CAFE standards would be "the biggest single step to curbing global warming." In their 1992 campaign book, Bill Clinton and Al Gore recommended raising CAFE to 40 mpg by 2000—a level whose potential safety consequences add more than a little irony to the book's title, "Putting People First."

SUV critics argue, to use Consumer Reports' words, that "most people who buy an SUV don't need one." But what one person doesn't need is largely a matter of another person's opinion. In the early 1800s the Duke of Wellington complained that the new railroads would "only encourage the common people to move about needlessly." Today the elitist view is that the masses still move about needlessly, only now they're doing it with four-wheel drive.

SUV owners have perfectly good reasons for their vehicle choices. Even Consumer Reports praises their "roomy interiors, commanding view of the road, and go-anywhere ability." The fact that NHTSA has trained its sights on SUVs hasn't kept its administrator, Ricardo Martinez, out of one. He puts his family in a Ford Explorer, though he declares that he bought it for safety, to distinguish himself from "some teenager" trying "to be cool." Too bad his regulatory approach doesn't do much for other people's safety.

In fact, much of the SUVs' recent popularity stems from CAFE itself. CAFE's restrictions took their greatest toll on large cars and station wagons. As economist Paul Godek pointed out in a study published last fall, light trucks were the only real alternative for consumers concerned about safety and seating capacity. In effect, he concludes, most of the weight forced off the passenger car fleet by CAFE has reappeared in the light truck fleet.

So the real problem is CAFE, not SUVs. The next time you hear the term SUV, remember: The "S" might as well stand for scapegoat.

Mr. Kazman is general counsel of the Competitive Enterprise Institute in Washington.

March 17, 1999

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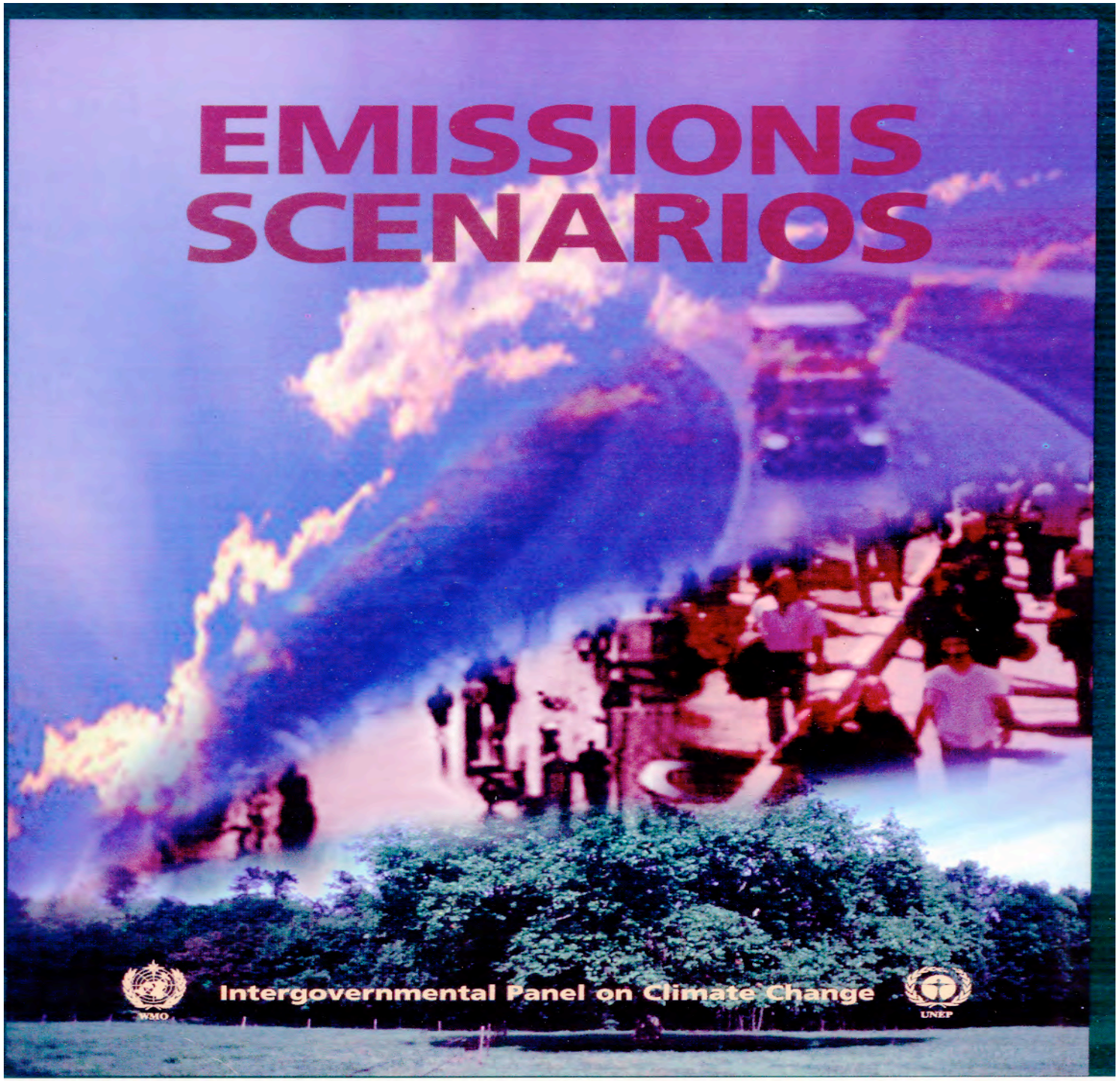
“The Words of the prophets are written on the…?”


MELTING
DOES WELL AT THE POLES.
THE NEW H2.
HUMMER
LIKE NOTHING ELSE.
VIACOM


Anderson
SUPERSTORE
ANDERSON


EMISSIONS
SCENARIOS
WMO
Intergovernmental Panel on Climate Change
UNEP

Projected CO_2 concentrations using IPCC storylines

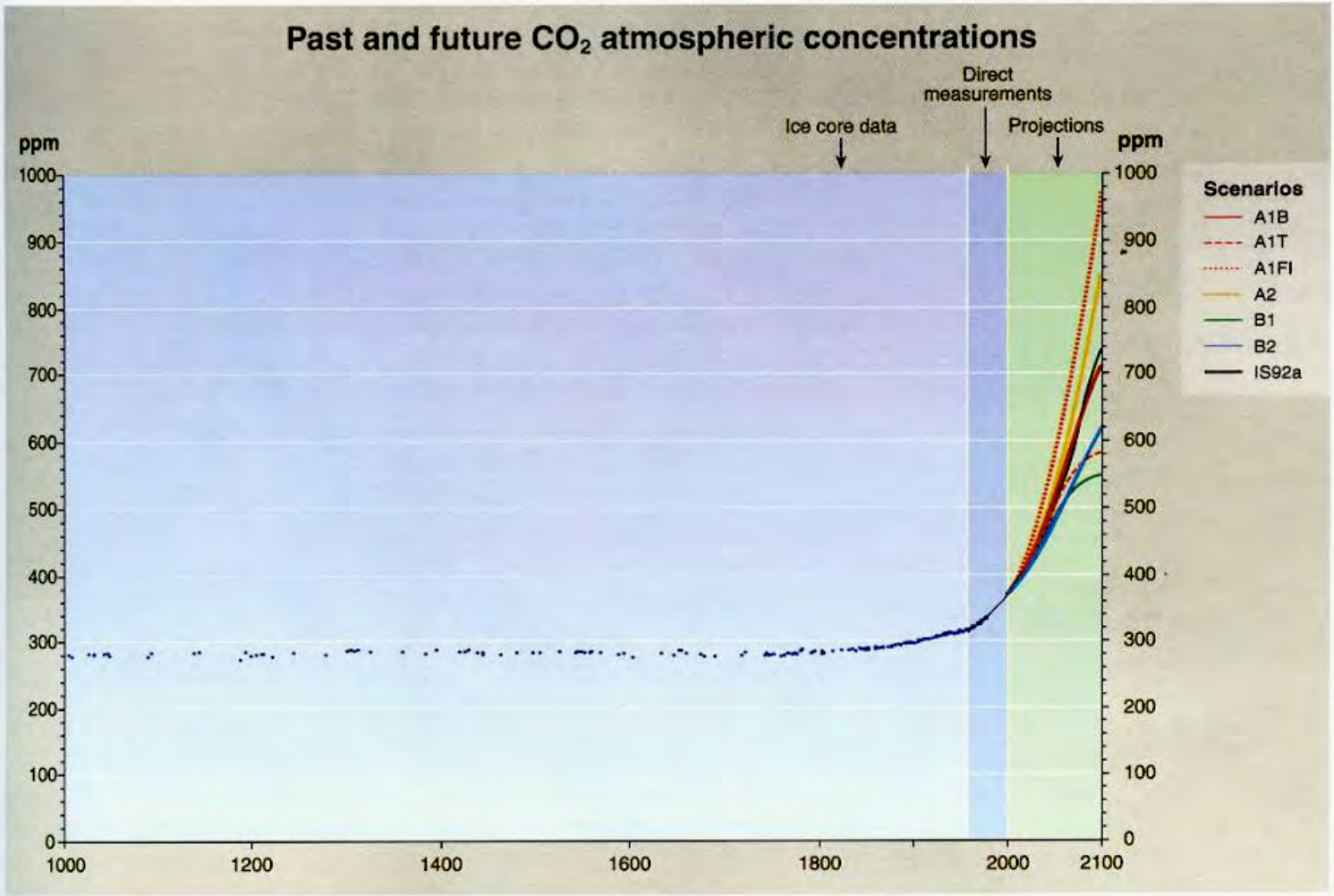


Figure SPM-10a: Atmospheric CO_2 concentration from year 1000 to year 2000 from ice core data and from direct atmospheric measurements over the past few decades. Projections of CO_2 concentrations for the period 2000 to 2100 are based on the six illustrative SRES scenarios and IS92a (for comparison with the SAR).

Q9 Figure 9-1a

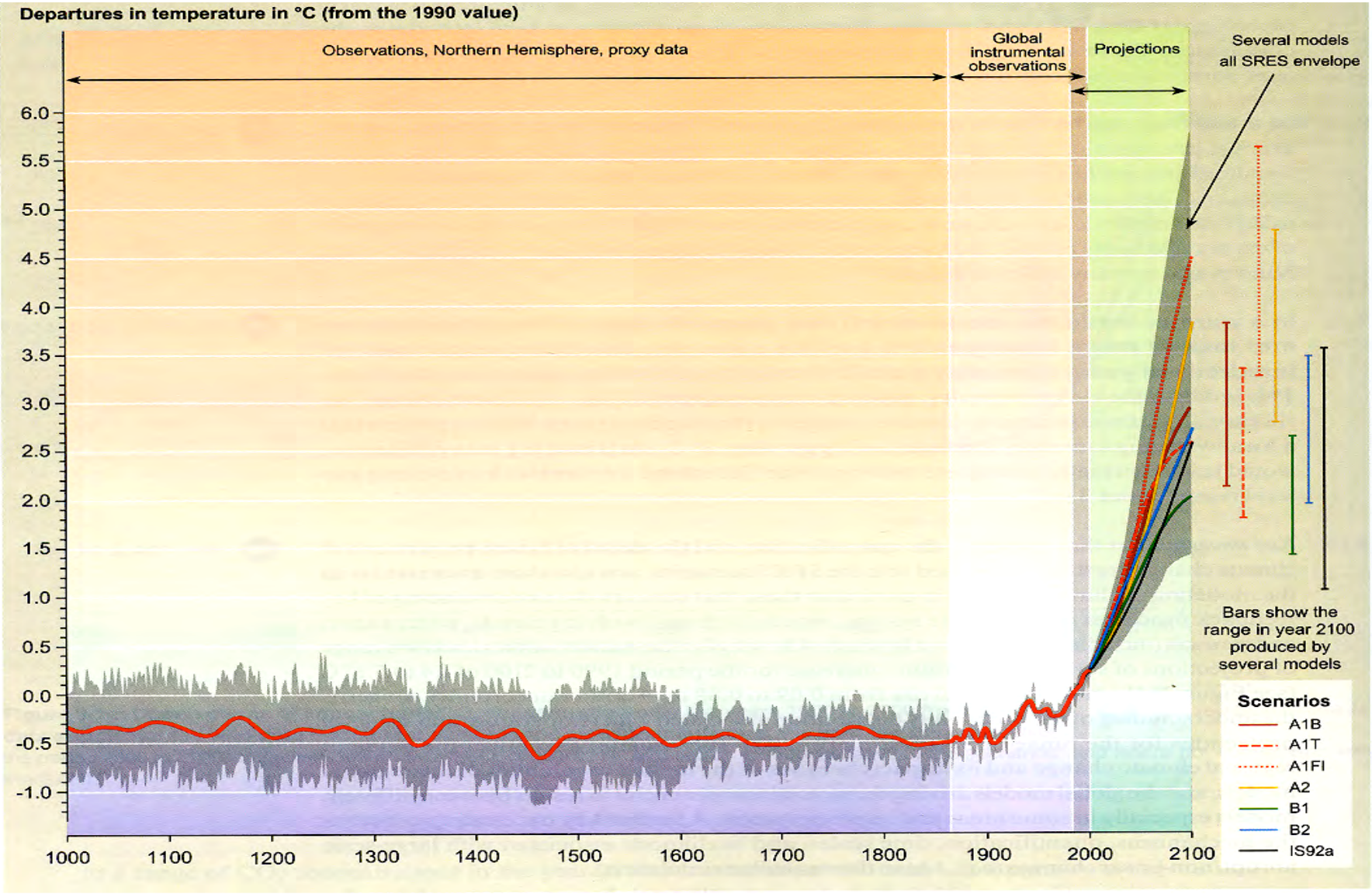
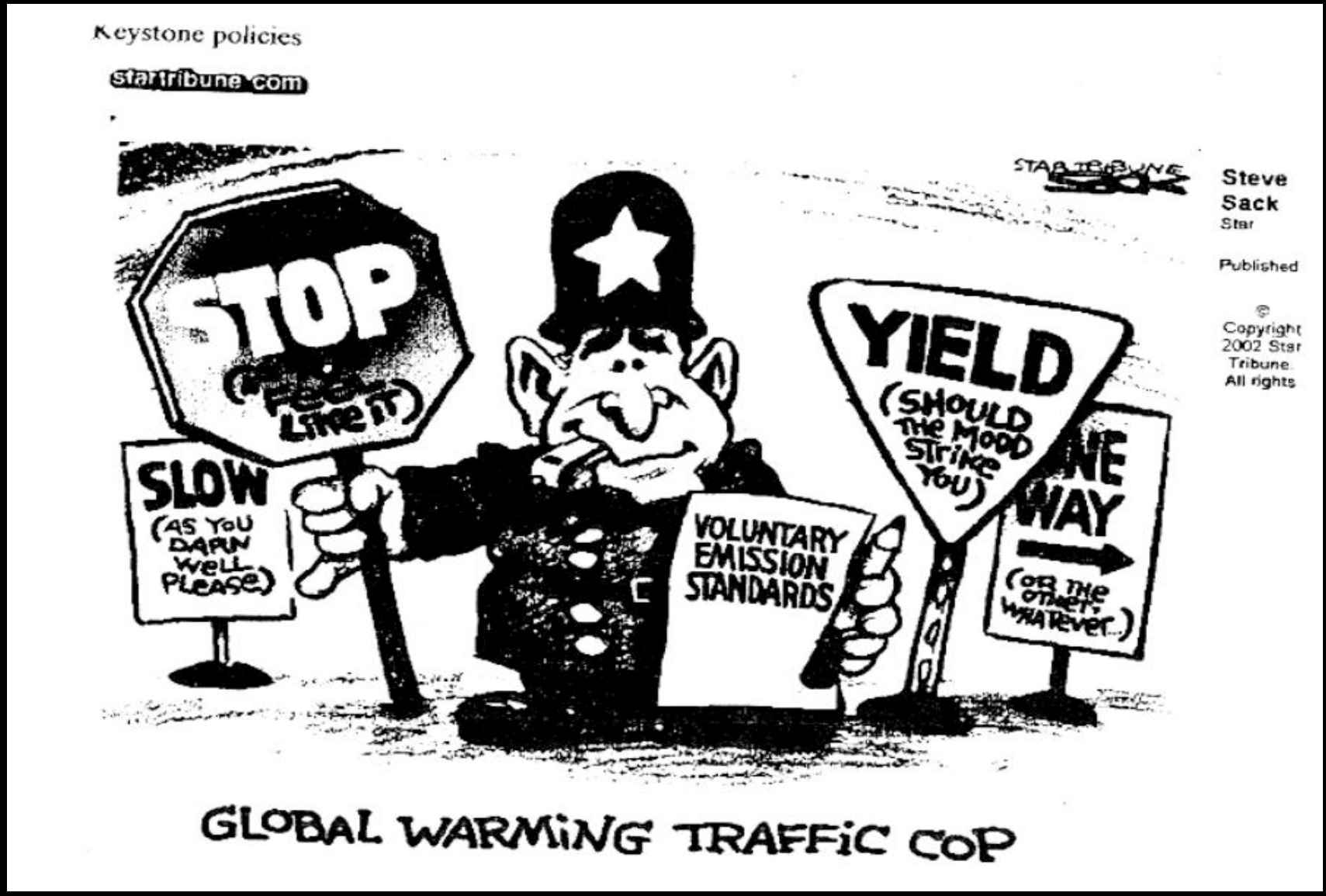


Figure 9-1b: Variations of the Earth's surface temperature: years 1000 to 2100. Over the period 1000 to 1860, observations are shown of variations in average surface temperature of the Northern Hemisphere (corresponding data from the Southern Hemisphere not available) constructed from proxy data (tree rings, corals, ice cores, and historical records). The line shows the 50-year average, and the grey region the 95% confidence limit in the annual data. From the years 1860 to 2000, observations are shown of variations of global and annual averaged surface temperature from the instrumental record. The line shows the decadal average. Over the period 2000 to 2100, projections are shown of globally averaged surface temperature for the six illustrative SRES scenarios and IS92a as estimated by a model with average climate sensitivity. The grey region "several models all SRES envelope" shows the range of results from the full range of 35 SRES scenarios in addition to those from a range of models with different climate sensitivities.

WGI TAR SPM Figures 1b & 5d

The Bush Administration's "climate policy"



Questions?

Comments??

PNAS

Probabilistic assessment of "dangerous" climate change and emissions pathways

Stephen H. Schneider*†‡ and Michael D. Mastrandrea*

*Center for Environmental Science and Policy, Stanford University, Encina Hall East, E-415, Stanford, CA 94305-6055; and †Department of Biological Sciences, Stanford University, Stanford, CA 94305-5020

This contribution is part of the special series of Inaugural Articles by members of the National Academy of Sciences elected on April 26, 2005.

Contributed by Stephen H. Schneider, July 26, 2005

Schneider and Mastrandrea, PNAS, 2005:

Owing to the many model-dependent assumptions inherent in the use of such highly simplified models, we emphasize that our quantitative results using this simple model are not intended to be taken literally, but we do suggest that the probabilistic framework and methods be taken seriously: they produce relative trends and general conclusions that better represent a risk-management approach than estimates made without probabilistic representation of outcomes. The demonstrated appli-

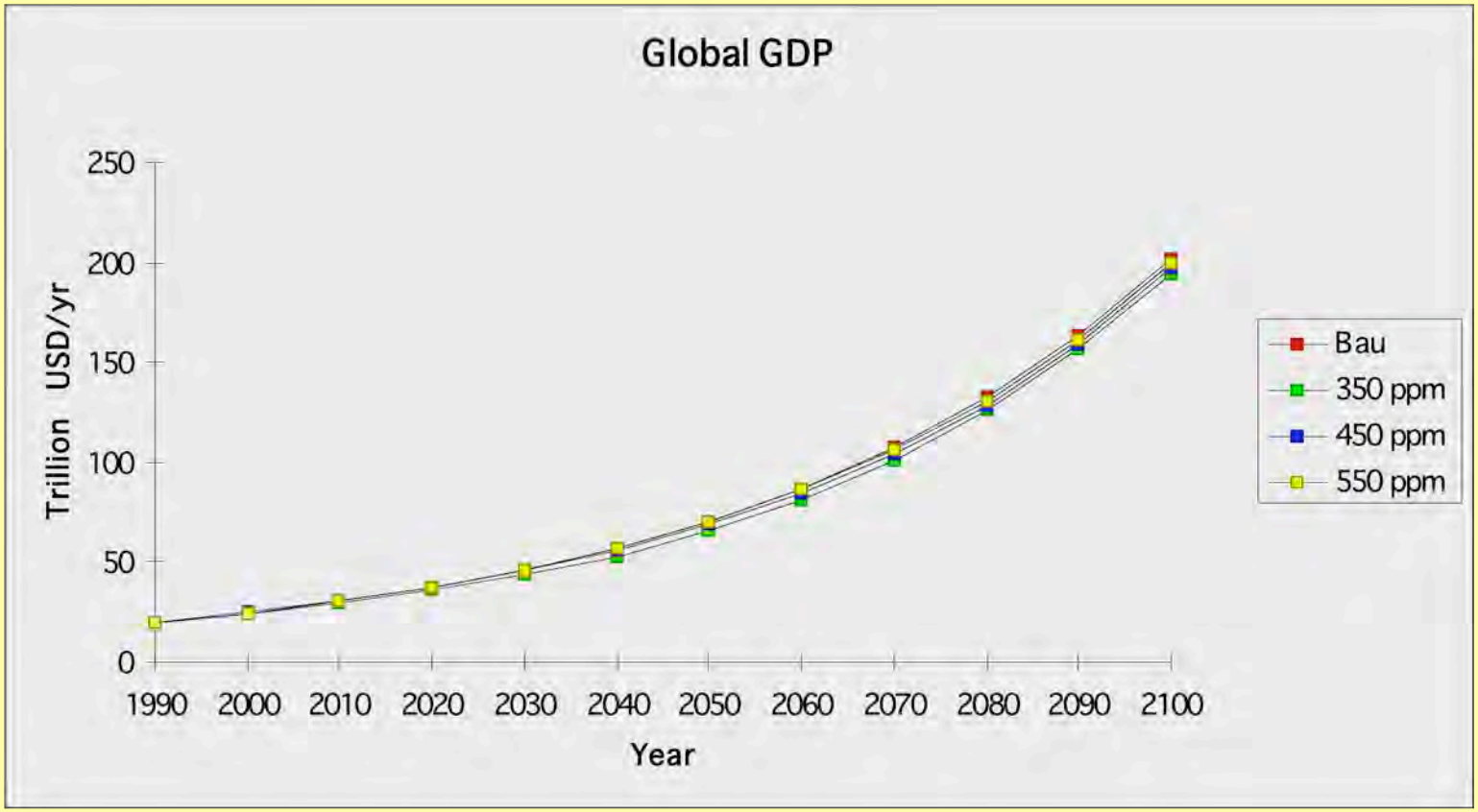
Decreasing Wine Grape Quality

Temperature Impacts

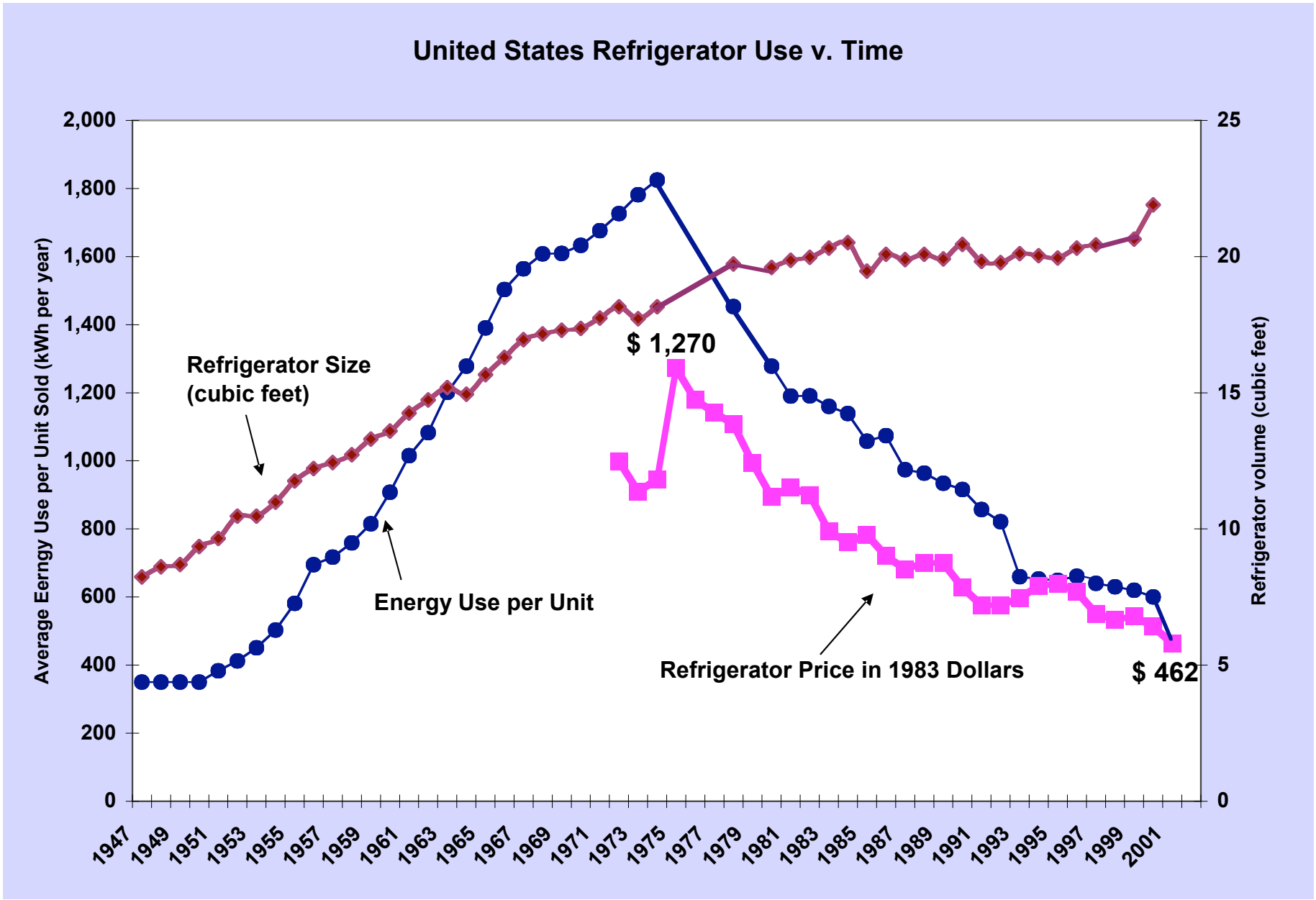
	1961-1990	2070-2099			
	Current Conditions	Lower Emissions (B1)		Higher Emissions (A1fi)	
		PCM	HadCM3	PCM	HadCM3
Wine Country	Optimal (mid)	Impaired	Marginal	Impared	Impaired
Cool Coastal	Optimal (low)	Optimal (mid-high)	Optimal (mid-high)	Optimal (high)	Impaired
Northern Central Valley	Marginal	Impaired	Impaired	Impaired	Impaired

Wine Country (Sonoma, Napa Counties)
Cool Coastal (Mendocino, Monterey Counties)
Northern Central Valley (San Joaquin, Sacramento Counties)

The cost to stabilise the atmosphere (II)

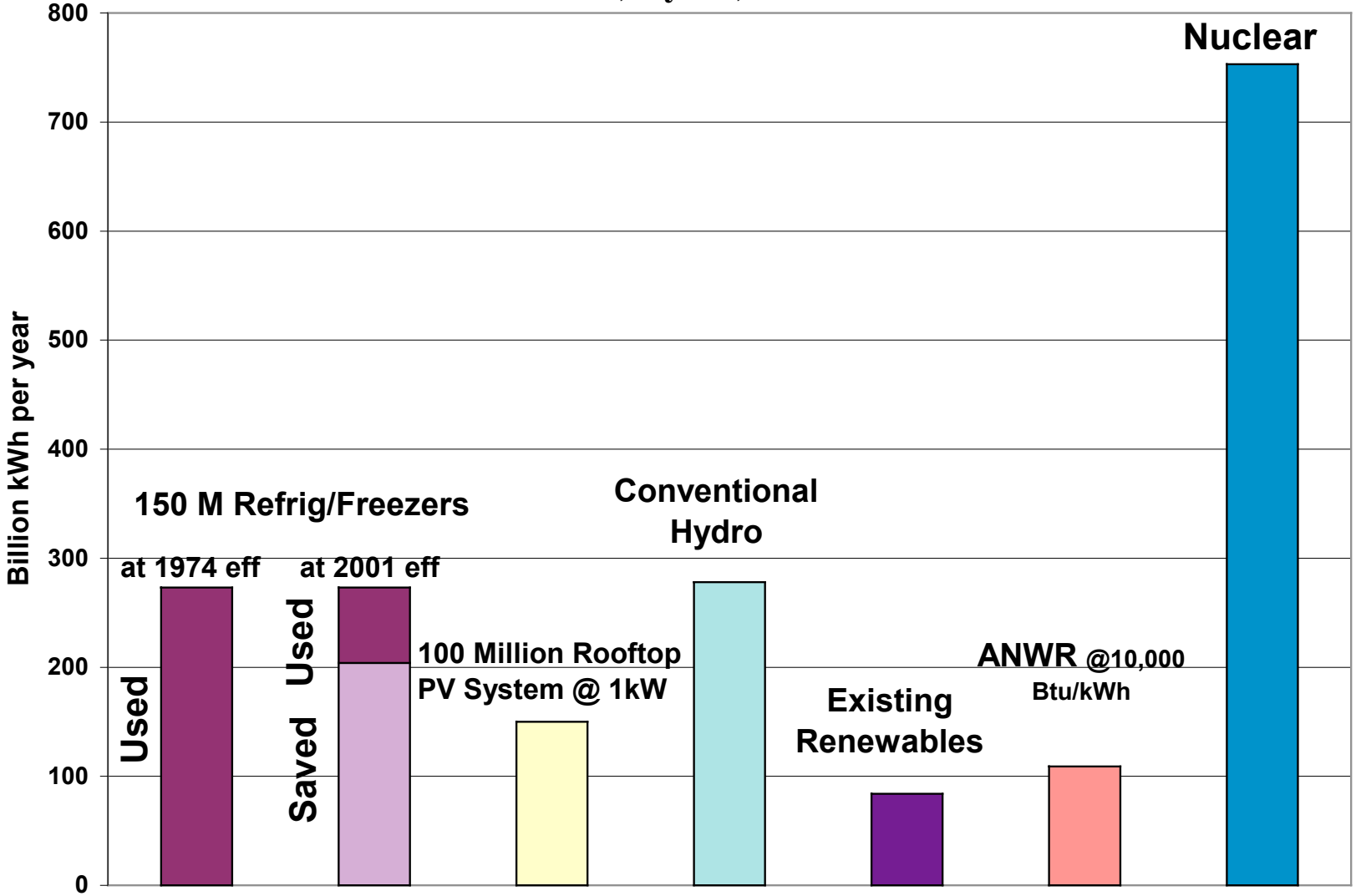


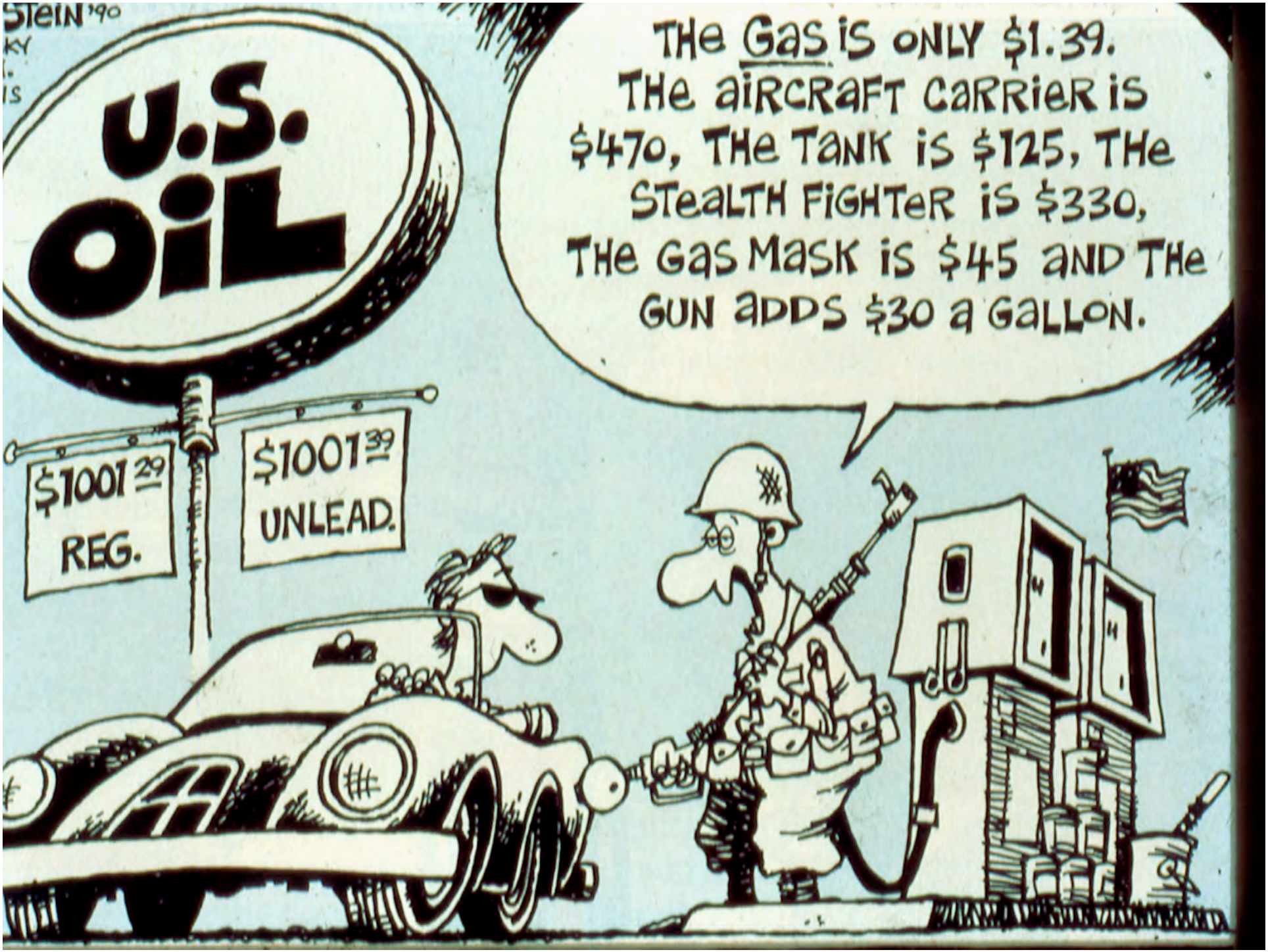
Source Azar & Schneider, 2002. Ecological Economics

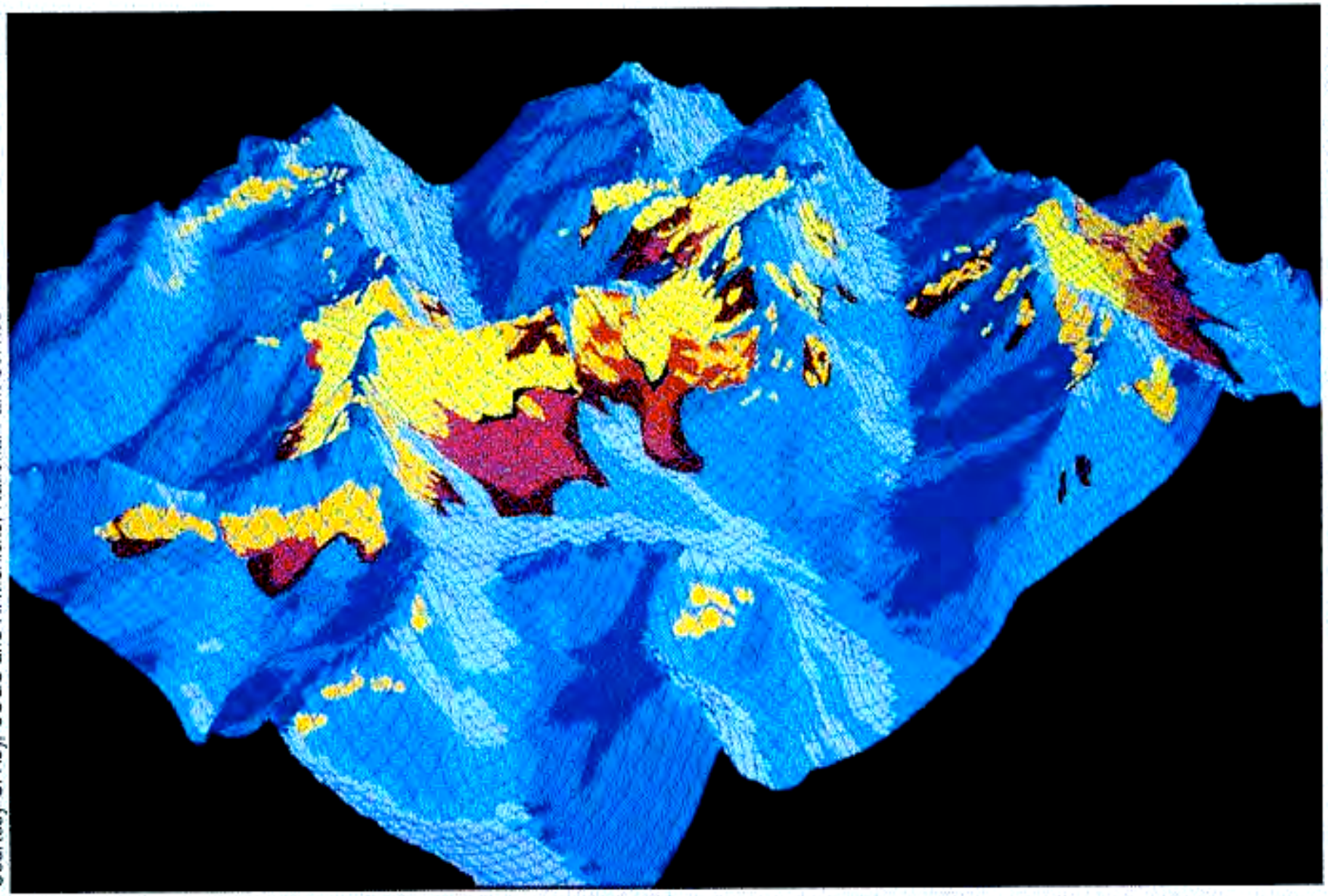


Source: David Goldstein

Electricity Use of Refrigerators and Freezers in the US compared to Generation from Nuclear, Hydro, Renewables and ANWR




STEIN '90
U.S. OIL
$1001 29 REG.
$1001 39 UNLEAD.
THE GAS IS ONLY $1.39. THE AIRCRAFT CARRIER IS $470, THE TANK IS $125, THE STEALTH FIGHTER IS $330, THE GAS MASK IS $45 AND THE GUN ADDS $30 A GALLON.



Courtesy C. Key, USGS and R. Menicke, National Park Service

Fig. 7. A geographic information system representation of glacier shrinkage from 1850 to 1993 in Glacier National Park. The Blackfeet–Jackson glaciers are in the center. The yellow areas reflect the current area of each glacier; other colors represent the extent of the glaciers at various times in the past.

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LETTERS

Increasing destructiveness of tropical cyclones over the past 30 years

Kerry Emanuel[1]

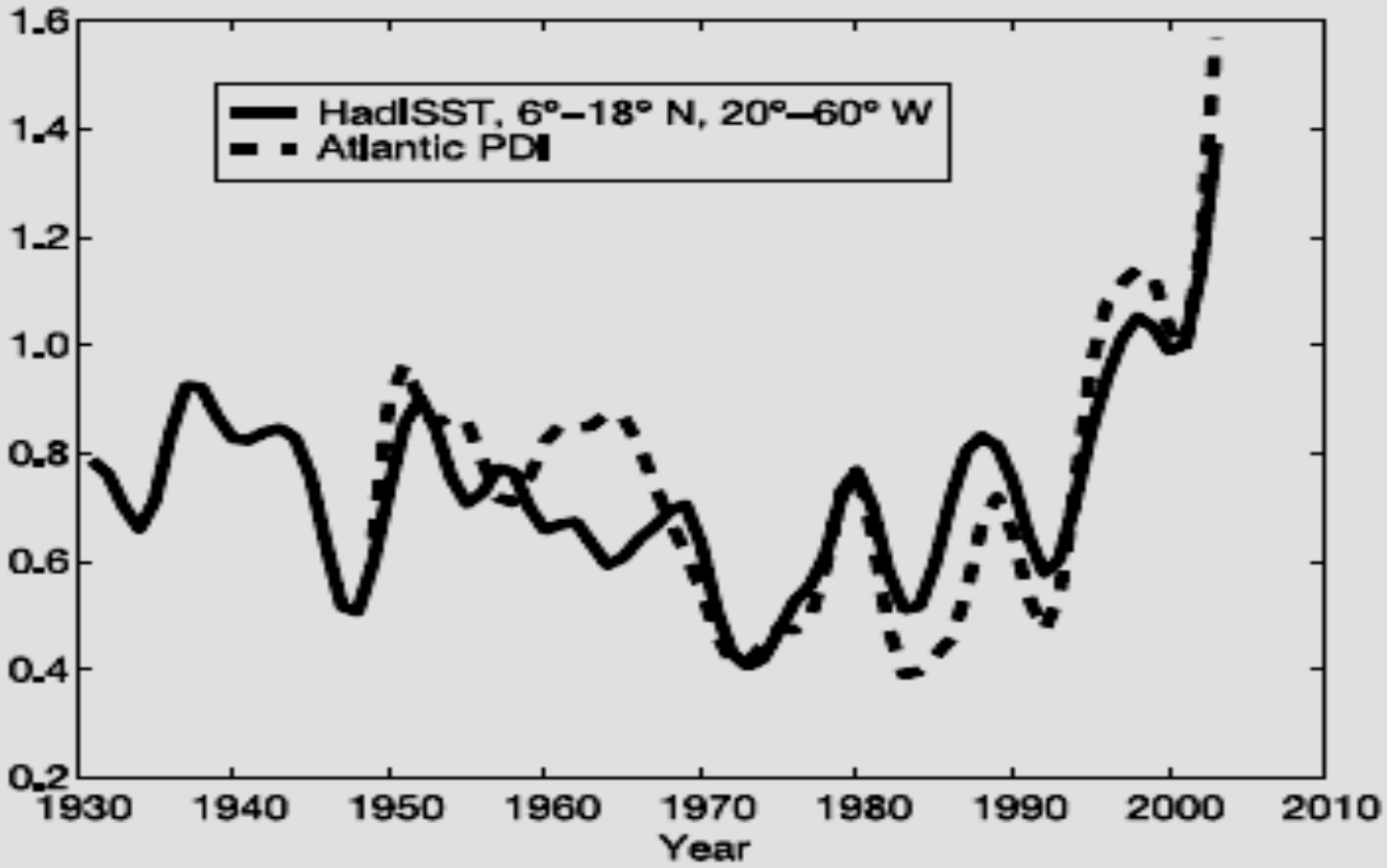

Figure 1 | A measure of the total power dissipated annually by tropical cyclones in the North Atlantic (the power dissipation index, PDI) compared to September sea surface temperature (SST). The PDI has been multiplied by 2.1×10^{-12} and the SST, obtained from the Hadley Centre Sea Ice and SST data set (HadISST)[22], is averaged over a box bounded in latitude by 6° N and 18° N, and in longitude by 20° W and 60° W. Both quantities have been smoothed twice using equation (3), and a constant offset has been added to the temperature data for ease of comparison. Note that total Atlantic hurricane power dissipation has more than doubled in the past 30 yr.

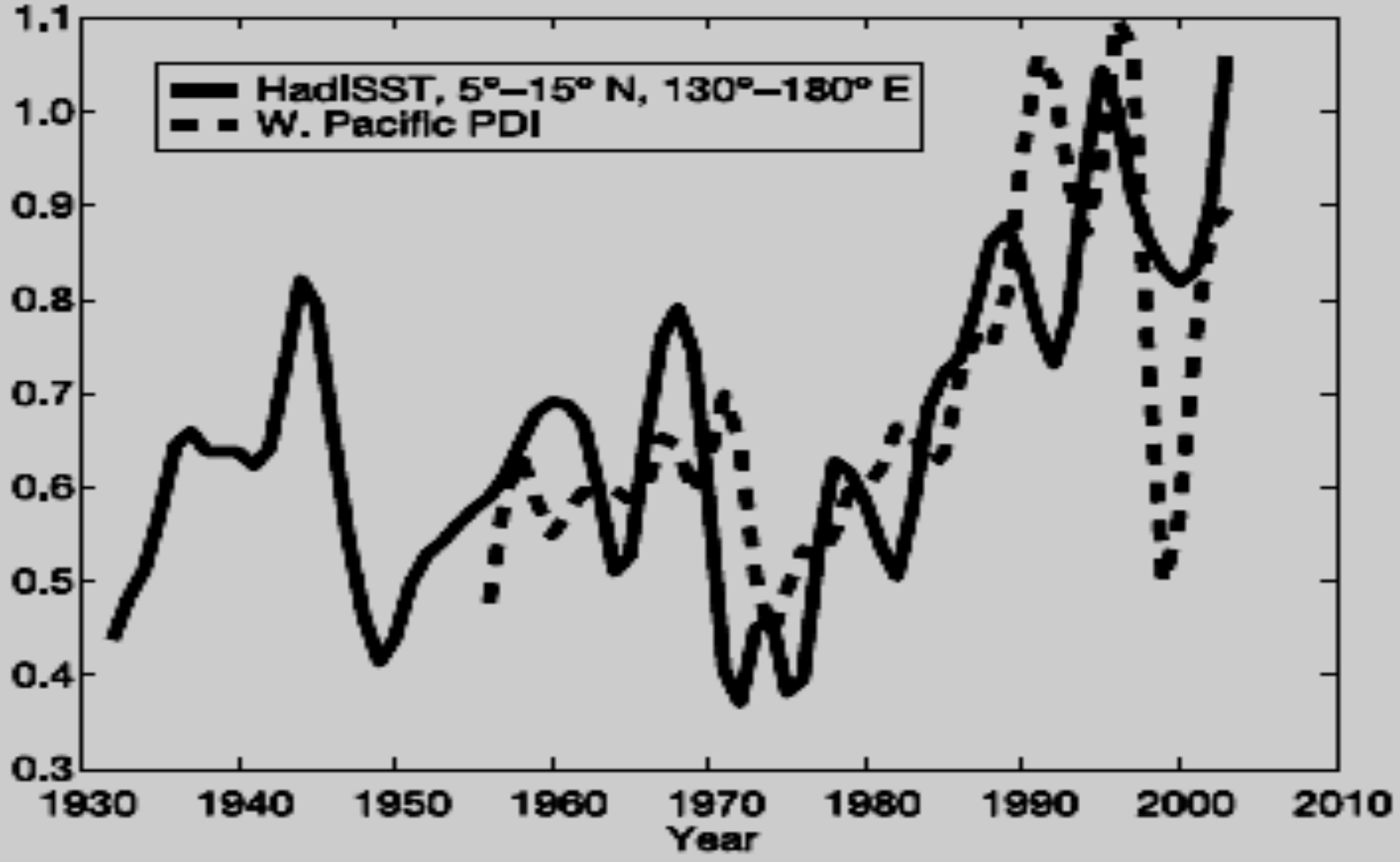

Figure 2 | Annually accumulated PDI for the western North Pacific, compared to July–November average SST. The PDI has been multiplied by a factor of 8.3×10^{-13} and the HadISST (with a constant offset) is averaged over a box bounded in latitude by 5° N and 15° N, and in longitude by 130° E and 180° E. Both quantities have been smoothed twice using equation (3). Power dissipation by western North Pacific tropical cyclones has increased by about 75% in the past 30 yr.

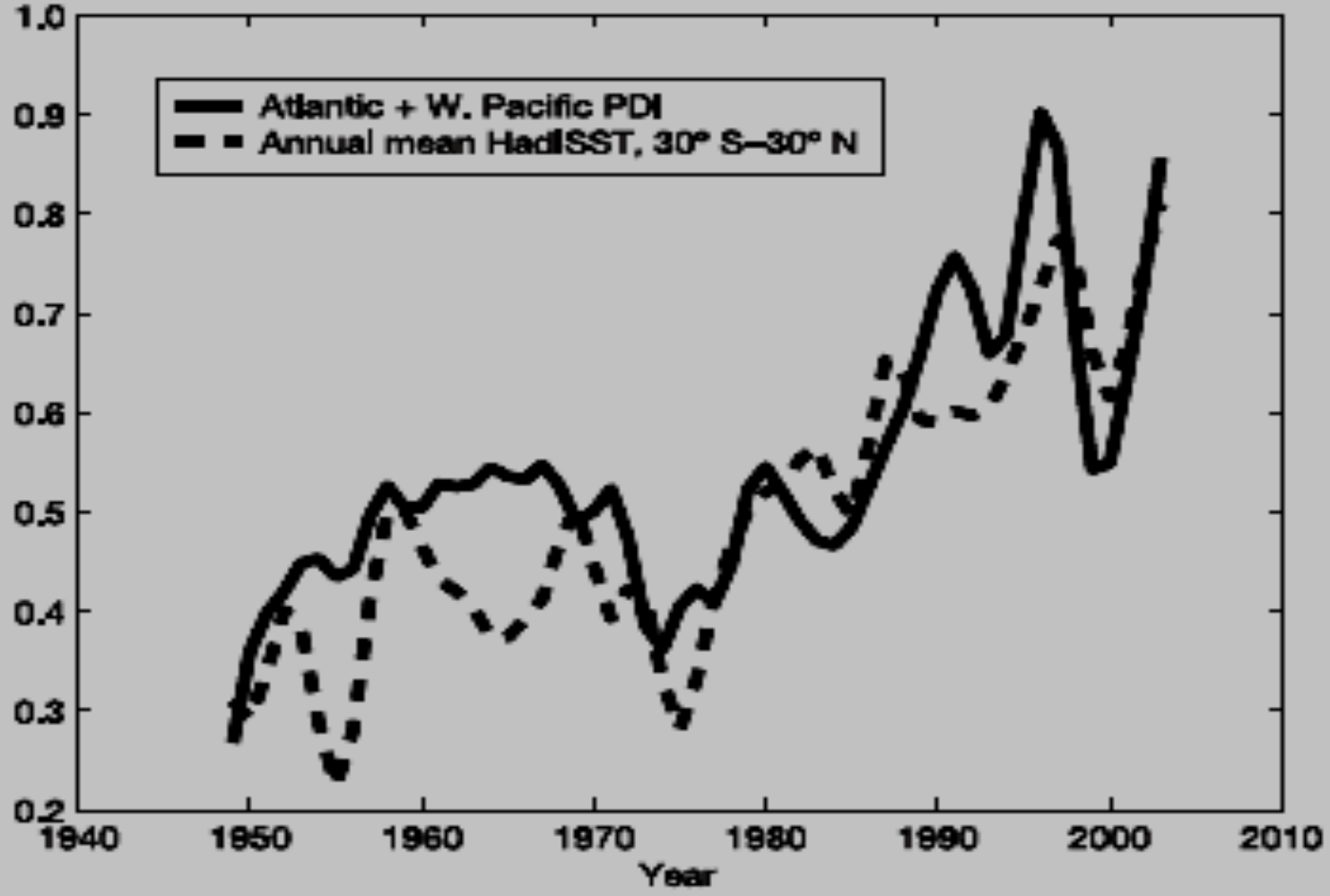

Figure 3 | Annually accumulated PDI for the western North Pacific and North Atlantic, compared to annually averaged SST. The PDI has been multiplied by a factor of 5.8×10^{-13} and the HadISST (with a constant offset) is averaged between 30° S and 30° N. Both quantities have been smoothed twice using equation (3). This combined PDI has nearly doubled over the past 30 yr.

The above discussion suggests that only part of the observed increase in tropical cyclone power dissipation is directly due to increased SSTs; the rest can only be explained by changes in other factors known to influence hurricane intensity, such as vertical wind shear. Analysis of the 250–850 hPa wind shear from reanalysis data, over the same portion of the North Atlantic used to construct Fig. 1, indeed shows a downward trend of 0.3 $m\,s^{-1}$ per decade over the period 1949–2003, but most of this decrease occurred before 1970, and at any rate the decrease is too small to have had much effect. Tropical cyclone intensity also depends on the temperature distribution of the upper ocean, and there is some indication that sub-surface temperatures have also been increasing[21], thereby reducing the negative feedback from storm-induced mixing.

Whatever the cause, the near doubling of power dissipation over the period of record should be a matter of some concern, as it is a measure of the destructive potential of tropical cyclones. Moreover, if